SR 64 CORRIDOR PROFILE STUDY

I-40 TO GRAND CANYON NATIONAL PARK

ADOT WORK TASK NO. MPD-0040-17
ADOT CONTRACT NO. 18-177972

DRAFT REPORT: PERFORMANCE AND NEEDS EVALUATION

AUGUST 2017

PREPARED FOR:

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Table of Contents

List of Figures

List of Tables

Appendices

ACRONYMS & ABBREVIATIONS

AADT	Average Annual Daily Traffic
ABISS	Arizona Bridge Information and Storage System
ADOT	Arizona Department of Transportation
AGFD	Arizona Game and Fish Department
ASLD	Arizona State Land Department
AZTDM	Arizona Statewide Travel Demand Model
BLM	Bureau of Land Management
BQAZ	Building a Quality Arizona
CCTV	Closed Circuit Television
CR	Cracking Rating
DCR	Design Concept Report
DMS	Dynamic Message Sign
EB	Eastbound
FHWA	Federal Highway Administration
FY	Fiscal Year
HCRS	Highway Condition Reporting System
HERE	Real time traffic conditions database produced by American Digital Cartography Inc.
HPMS	Highway Performance Monitoring System
I-	Interstate
IRI	International Roughness Index
ITS	Intelligent Transportation System
LCCA	Life-Cycle Cost Analysis
LOS	Level of Service
LRTP	Long-Range Transportation Plan
MAP-21	Moving Ahead for Progress in the 21st Century
MP	Milepost
MPD	Multimodal Planning Division
NACOG	Northern Arizona Council of Governments
NPV	Net Present Value
OP	Overpass
P2P	Planning-to-Programming
PA	Project Assessment
PARA	Planning Assistance for Rural Areas
PDI	Pavement Distress Index
PES	Performance Effectiveness Score
PSR	Pavement Serviceability Rating
PTI	Planning Time Index
RTP	Regional Transportation Plan
RWIS	Road Weather Information System
SATS	Small Area Transportation Study
SERI	Species of Economic and Recreational Importance
SHSP	Strategic Highway Safety Plan
SOV	Single Occupancy Vehicle
SR	State Route
TAC	Technical Advisory Committee
TI	Traffic Interchange
TIP	Transportation Improvement Plan
TPTI	Truck Planning Time Index
TTI	Travel Time Index
TTTI	Truck Travel Time Index
UP	Underpass
USDOT	United States Department of Transportation
V/C	Volume-to-Capacity Ratio
VMT	Vehicle-Miles Travelled
WB	Southbound
WIM	Weigh-in-Motion

1.0 INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this Corridor Profile Study (CPS) of State Route 64 (SR 64) between Interstate 40 (I-40) and Grand Canyon National Park. The study examines key performance measures relative to the SR 64 corridor, and the results of this performance evaluation are used to identify potential strategic improvements. The intent of the corridor profile program, and of ADOT's Planning-to-Programming (P2P) process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network.

ADOT has completed eleven CPS as part of three separate groupings or rounds.

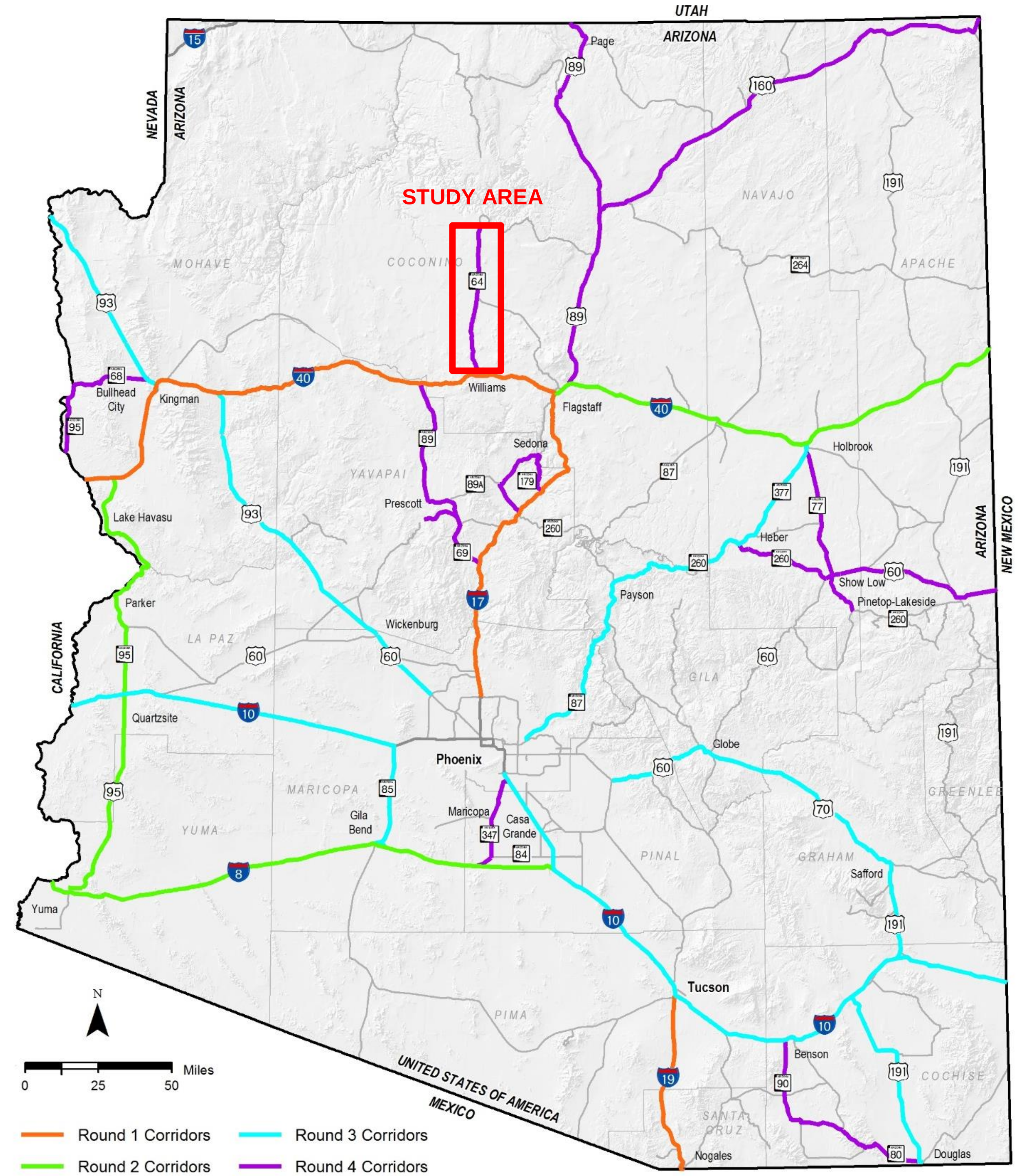
The fourth round (Round 4) of studies began in Spring 2017, and include:

- US 89: I-40 to Utah Stateline
- US 160: US 89 to New Mexico Stateline
- SR 64: I-40 to Grand Canyon National Park
- SR 68: SR 95 to US 93 and SR 95: California Stateline to Nevada Stateline
- SR 69: I-17 to SR 89; Fain Rd: SR 69 to SR 89A; SR 89A: Fain Rd to SR 89; SR 89: SR 89A to I-40
- SR 77: US 60 to SR 377
- SR 90: I-10 to SR 80 and SR 80: SR 90 to US 191
- SR 179: I-17 to SR 89A; SR 89A: SR 179 to SR 260; and SR 260: SR 89A to I-17
- SR 260: SR 277 to SR 73 and US 60: SR 260 to New Mexico Stateline
- SR 347: I-10 to SR 84 and SR 84: SR 347 to I-8

The studies under this program assess the overall health, or performance, of the state's strategic highways. The CPS will identify candidate solutions for consideration in the Multimodal Planning Division's (MPD) P2P project prioritization process, providing information to guide corridor-specific project selection and programming decisions.

The SR 64 corridor, depicted in **Figure 1,** is one of the strategic statewide corridors identified and the subject of this Round 4 CPS.

Figure 1: Corridor Study Area



1.1 Corridor Study Purpose

The purpose of the CPS is to measure corridor performance to inform the development of strategic solutions that are cost-effective and account for potential risks. This purpose can be accomplished by following the process described below:

- Inventory past improvement recommendations
- Define corridor goals and objectives
- Assess existing performance based on quantifiable performance measures
- Propose various solutions to improve corridor performance
- Identify specific solutions that can provide quantifiable benefits relative to the performance measures
- Prioritize solutions for future implementation, accounting for performance effectiveness and risk analysis findings

1.2 Study Goals and Objectives

The objective of this study is to identify a recommended set of prioritized potential solutions for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The SR 64 CPS defines solutions and improvements for the corridor that are evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance. Corridor benefits can be categorized by the following three investment types:

- Preservation: Activities that protect transportation infrastructure by sustaining asset condition or extending asset service life
- Modernization: Highway improvements that upgrade efficiency, functionality, and safety without adding capacity
- Expansion: Improvements that add transportation capacity through the addition of new facilities and/or services

This study identifies potential actions to improve the performance of the SR 64 corridor. Proposed actions are compared based on their likelihood of achieving desired performance levels, life-cycle costs, cost-effectiveness, and risk analysis to produce a prioritized list of solutions that help achieve corridor goals.

The following goals are identified as the desired outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals
- Develop solutions that address identified corridor needs based on measured performance
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure

1.3 Corridor Overview and Location

SR 64 serves as the entrance road to the South Rim of Grand Canyon National Park. It connects the Canyon South Rim with the City of Williams on I-40, 60 miles to the south. The mostly two-lane road travels in a north-south direction through a scenic landscape of rolling hills, grasslands and forest. While the road serves a few smaller communities along the route (e.g., Valle and Tusayan), the primary purpose of the road is to provide access to Grand Canyon National Park. Since the South Rim of the Grand Canyon attracts over 5 million visitors each year and is by far is the most visited side of the Canyon, SR 64 carries a very high volume of recreational traffic. The Grand Canyon is also one of the most accessible National Parks with a wide variety of amenities that draw visitors throughout the year. That accessibility places heavy demands on SR 64, particularly during the summer months.

There are few alternatives to SR 64 for most visitors to the National Park, hence maintaining the roadway in good condition at all times regardless of weather or travel demand is required. The sensitive environment places significant limits on the prospect of any widening of the road in many places as does the South Rim visitor capacity.

Initially constructed as Arizona Forest Highway 2 in the late 1920s and early 1930s as an 18-foot roadway, the facility was taken into the State Highway System as SR 64 in 1932. It was reconstructed to its current alignment and basic 34-foot roadway width in the 1950s and 1960s. Climbing lanes, minor widening and intersection improvements have occurred as well as reconstruction and widening in the Tusayan area.

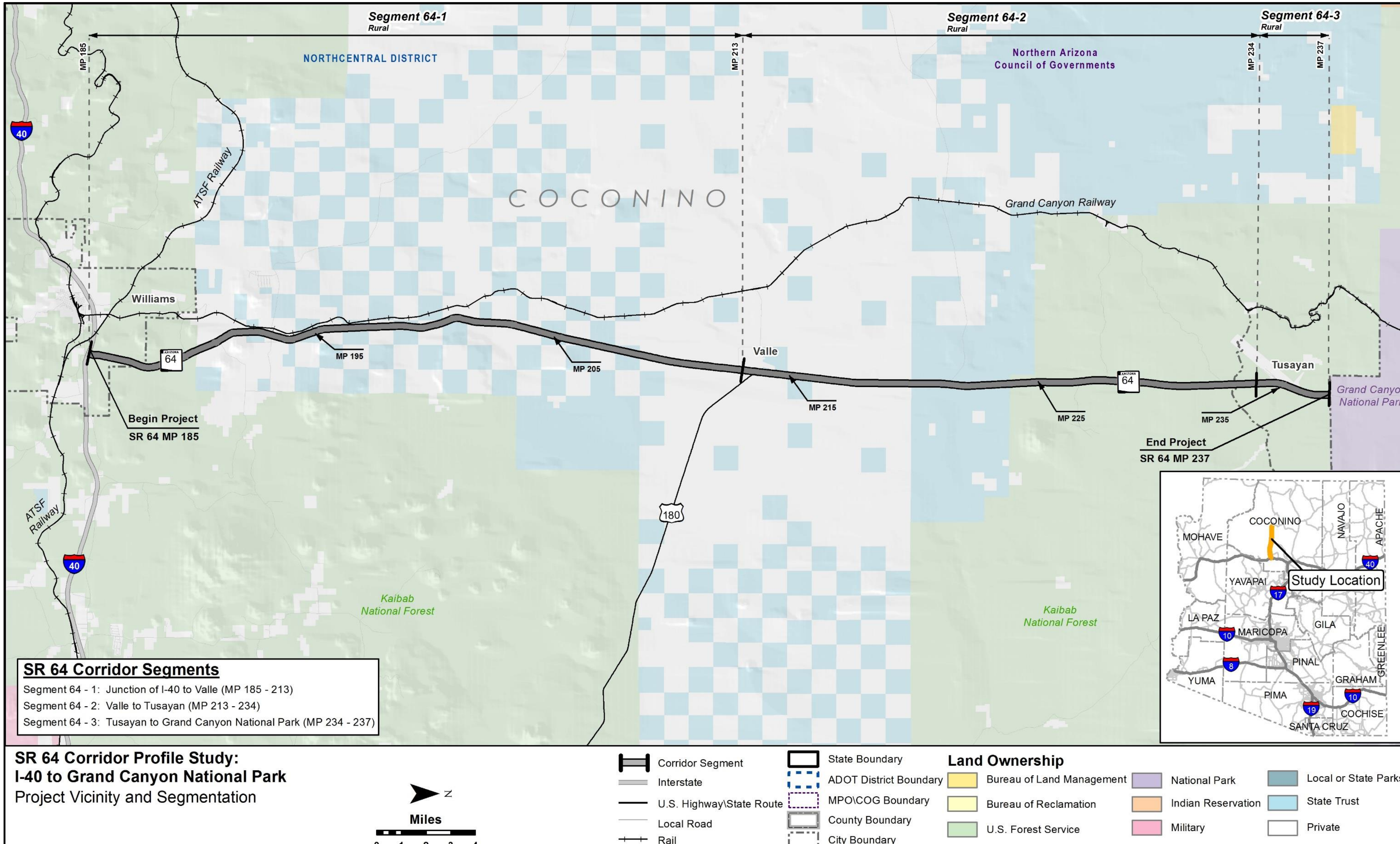
1.4 Corridor Segments

The SR 64 corridor is divided into 3 planning segments to allow for an appropriate level of detailed needs analysis, performance evaluation, and comparison between different segments of the corridor. The corridor is segmented at logical breaks where the context changes due to differences in characteristics such as terrain, daily traffic volumes, or roadway typical sections. Corridor segments are described in **Table 1** and shown in **Figure 2**.

Table 1: SR 64 Corridor Segments

Segment #	Route	Begin	End	Approx. Begin Milepost	Approx. End Milepost	Approx. Length (miles)	Typical Through Lanes (EB, WB)	2015/2035 Average Annual Daily Traffic Volume (vpd)	Character Description
64-1	SR 64	Junction of I-40	Valle	185	213	28	1,1	7,000 / 9,000	This rural highway road with uninterrupted flow has rolling topography and consistent traffic volumes.
64-2	SR 64	Valle	Tusayan	213	234	21	1,1	6,000 / 8,000	Segment 2 has uninterrupted flow characteristics in a rural setting. Notable is the junction with US 180 at the beginning of the segment that connects to Flagstaff.
64-3	SR 64	Tusayan	Grand Canyon National Park	234	237	3	2,2	7,000 / 10,000	The short, mostly four-lane segment passes through the town of Tusayan before arriving at the entrance of Grand Canyon National Park. It has an interrupted flow due to the town's two roundabouts.

Figure 2: Corridor Location and Segments



1.5 Corridor Characteristics

The SR 64 corridor is an important travel corridor in the central/northeastern part of the state. The corridor functions as a route for recreational, tourist, and regional traffic and provides critical connections between the communities it serves and the rest of the regional and interstate network.

National Context

The SR 64 corridor provides access to the Grand Canyon National Park from I-40 and SR 180.

Regional Connectivity

The SR 64 corridor between I-40 and the Grand Canyon National Park provides movement for freight, tourism, and recreation needs within Arizona. The corridor is located in the North Central ADOT District; the Northern Arizona Council of Governments (NACOG); and in Coconino County. Within the corridor study limits, SR 64 offers connections to several major roadways, including I-40 and SR 180. This corridor serves Arizona cities and towns including Williams, Valle, Tusayan, and Grand Canyon Village.

Commercial Truck Traffic

Communities along the SR 64 corridor are dependent on the corridor to access the state economy through freight deliveries and travel to other locations. Freight traffic (trucks) comprise from 13.8% to 16.5% of the total traffic flow on the corridor, with the higher truck percentages between Valle and Grand Canyon Airport Road.

Commuter Traffic

A majority of the commuter traffic along the SR 64 corridor occurs within the urbanized areas of Williams, Valle and Tusayan. Staff necessary to run and support the commercial development within Tusayan, Grand Canyon National Park, and Kaibab National Forest must commute along SR 64 due to the limited supply of nearby residential housing. These areas are economic centers along what is considered mostly a rural combination of local roads and Forest Service routes. According to the most recent traffic volume data maintained by ADOT, traffic volumes range from approximately 4,400 vehicles per day between Spring Valley Road and Valle to approximately 7,400 vehicles per day near the Grand Canyon Airport and entrance to the Grand Canyon.

According to the 2015 American Community Survey data from the US Census Bureau, 74% of the workforce in areas along the corridor relies on a private vehicle to get to work.

Recreation and Tourism

SR 64 provides access to many Arizona attractions such as Grand Canyon National Park, Kaibab National Forest, and other recreational activities. Other recreational destinations accessible from the SR 64 corridor include Kaibab Lake Campground (via FR 47), Ten-X Campground (2 miles south of Tusayan), Red Butte Trail (via FR 305/320), and Beal Wagon Road Historic Trail (via FR 141 and 84), among others.

Multimodal Uses

Freight Rail

The BNSF Railway, one of the top transporters of intermodal freight in North America, crosses through the City of Williams. The BNSF "Transcon Corridor" connects Los Angeles with Chicago and passes through northern Arizona, paralleling I-40. The BNSF Transcon Corridor typically carries up to about 120 trains per day. The Williams and SR 64 Junction is also the northern point of service for the Arizona Central Railroad/Verde Canyon Railroad, and the BNSF Railway North-South Corridor which ends in Phoenix[1]. Unique to SR 64 is the Grand Canyon Railway, which is a passenger train providing scenic recreational riding packages from Williams to the South Rim of the Grand Canyon National Park.

Passenger Rail

Amtrak's Southwest Chief Chicago to Los Angeles route primarily serves long-distance tourist travel, with daily service. The Southwest Chief shares track on the BNSF Transcon Corridor and is subject to delays caused by freight traffic. It travels at an average speed of 63 miles per hour across the State. There is a passenger station in Williams Junction. The Thruway Bus connects Amtrak passengers to the Grand Canyon Railway Station.

Bicycles/Pedestrians

Opportunities for bicycle and pedestrian travel are limited on SR 64. Bicycle traffic is permitted on the mainline outside shoulder; however, outside effective shoulder widths are less than the preferred 4-foot minimum width and include rumble strips in some areas. **Table 3** includes recommendations to improve/widen shoulders along the SR 64 corridor and include the corridor as a part the U.S. Bike Route 79.

Bus/Transit

Bus/transit services along the SR 64 corridor cater mostly to customers visiting the Grand Canyon National Park. In Tusayan, visitors can utilize the Park and Ride and take the Purple Route shuttle bus service to the park and back. The shuttle bus has 4 additional routes (Blue, Orange, Red, and Hiker Express) that provide services into the park. There are no other transit services offered within the corridor, although there are a range of private operators providing private tourist bus service.

Aviation

There are three general aviation facilities in proximity to the SR 64 corridor. These include the Grand Canyon National Park Airport, the H.A. Clark Memorial Airport, and the Valle Airport, which is privately owned and operated.

[1] Source: Arizona Multimodal Freight Analysis Study (2009), Appendix A

Land Ownership, Land Uses and Jurisdictions

As shown previously in **Figure 2**, the SR 64 corridor traverses multiple jurisdictions and land owned or managed by various entities within Coconino County. The southern section of the corridor traverses the Kaibab National Forest. A majority of the corridor (from approximately MP 190 to MP 225) traverses interspersed sections of private and county/city/state park land. The northern section of the corridor traverses through the northern portion of Kaibab National Forest.

Population Centers

Population centers of various sizes exist along the SR 64 corridor. **Table 2** provides a summary of the populations for communities along the corridor. Low to moderate population growth is projected between 2010 and 2040 in the major population centers along the corridor according to the Arizona State Demographer's Office.

Table 2: Current and Future Population

Community	2010 Population	2015 Population	2040 Population	% Change 2010-2040	Total Growth
Coconino County	134,679	141,602	167,897	25%	33,218
Williams	3,023	3,185	3,370	11%	347
Valle	832	858	930	12%	98
Tusayan	558	589	600	8%	42

Source: U.S. Census, Arizona Department of Administration – Employment and Population Statistics

Major Traffic Generators

The Grand Canyon National Park is the major traffic generator for the SR 64 corridor.

Tribes

There are no tribal reservations within the SR 64 corridor.

Wildlife Linkages

The Arizona State Wildlife Action Plan (SWAP) provides a 10-year vision for the entire state, identifying wildlife and habitats in need of conservation, insight regarding the stressors to those resources, and actions that can be taken to alleviate those stressors. Using the Habimap Tool that creates an interactive database of information included in the SWAP, the following were identified in relation to the SR 64 corridor:

- Arizona Game and Fish Department (AGFD) Wildlife Waters are scattered near the corridor, specifically in the areas near Tusayan
- Arizona Important Bird Areas: The northern point of the corridor is near the Grand Canyon NP-Lipan and Yaki Raptor Migration Points Important Bird Area
- The corridor travels through allotments controlled by the Arizona State Land Department (ASLD) and United States Forest Service
- A moderate Riparian area is located near the southern point of the corridor
- Arizona Wildlife Linkages: No missing linkages are noted, but there are potential Arizona Wildlife Linkage Zones along SR 64 from MP 190 to MP 224
- According to the Species and Habitat Conservation Guide (SHCG), sensitive habitats that have moderate to high conservation potential exist along the corridor; these areas are located near the Town of Tusayan in the north and near the Williams and SR 64 Junction in the south
- Areas where Species of Greatest Conservation Need (SGCN) are high or moderately vulnerable are located along the entire SR 64 corridor
- Identified areas of moderate or high levels of Species of Economic and Recreational Importance (SERI) are in the vicinity south of the Town of Valle, and north of MP 224 leading into the Town of Tusayan and the park

Corridor Assets

Corridor transportation assets are summarized in **Figure 3**. Four passing lanes exist on the corridor between MP 185 and MP 226. The corridor includes one grade-separated traffic interchange (TI) at the I-40 Junction.

Other assets include a Roadside Weather Information System (RWIS) located at MP 185 and closed-circuit television (CCTV) cameras are located at MP 213.9. The corridor also includes approximately 30 informal pull-offs located along the route.

1.6 Corridor Stakeholders and Input Process

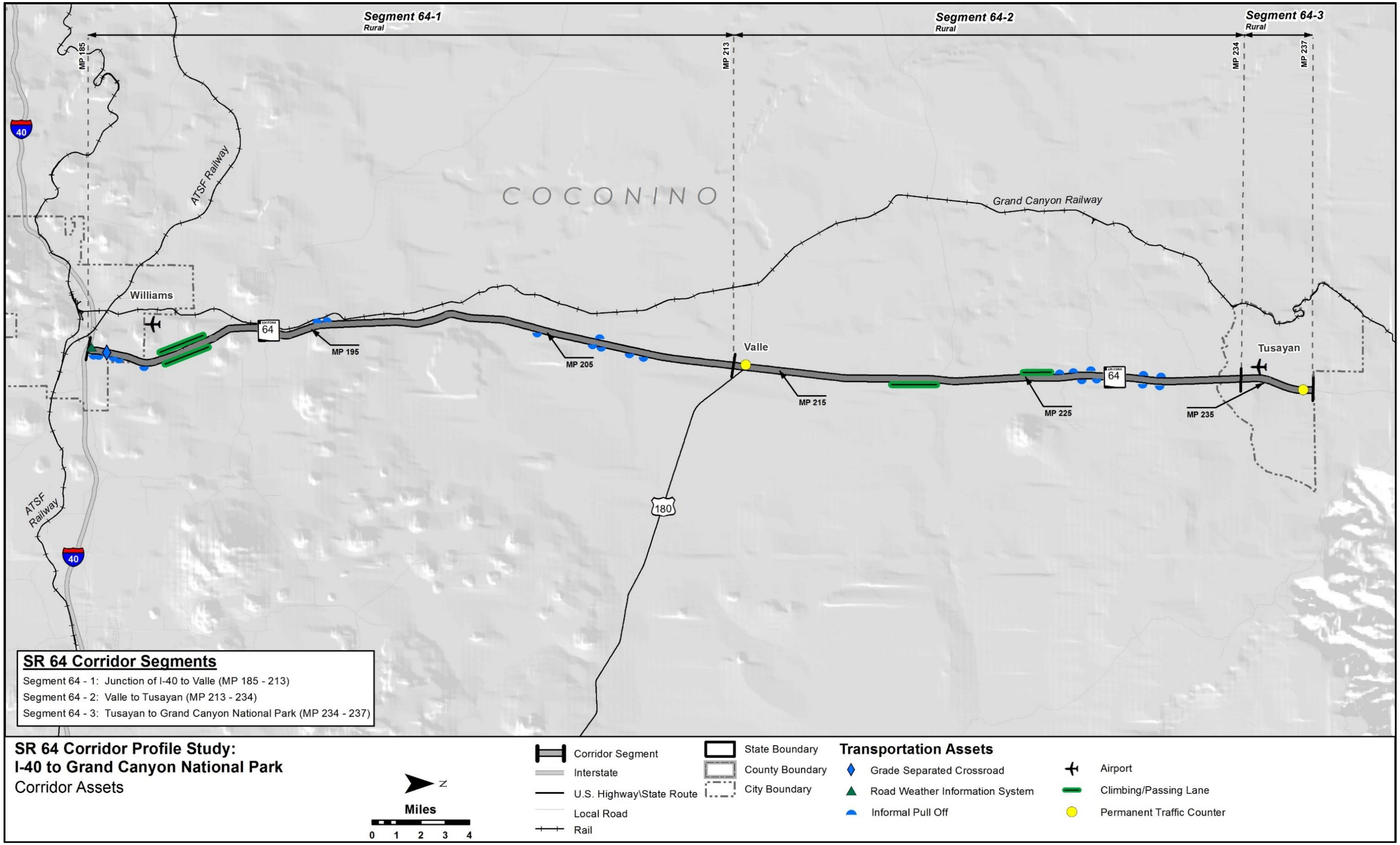
A Technical Advisory Committee (TAC) was created comprised of representatives from key stakeholders. TAC meetings will be held at key milestones to present results and obtain feedback. In addition, several meetings plan to be conducted with key stakeholders between July 2017 and December 2017 to present the results and obtain feedback.

Key stakeholders identified for this study included:

- ADOT North Central District
- ADOT Technical Groups
- NACOG
- AGFD
- ASLD
- Federal Highway Administration (FHWA)

Two draft report documents will be prepared during the development of the CPS. The first draft document includes the corridor performance evaluation and needs assessment (this report). The second draft document includes the solution development, evaluation and prioritization. Both will be provided to the TAC for review and comment, then combined into a comprehensive final report.

Figure 3: Corridor Assets



1.7 Prior Studies and Recommendations

This study identified recommendations from previous studies, plans, and preliminary design documents. Studies, plans, and programs pertinent to the SR 64 corridor were reviewed to understand the full context of future planning and design efforts within and around the study area. These studies are organized below into four categories: Framework and Statewide Studies, Regional Planning Studies, Planning Assistance for Rural Areas (PARAs) and Small Area Transportation Studies (SATS), and Design Concept Reports (DCRs) and Project Assessments (PAs).

Framework and Statewide Studies

- ADOT Bicycle and Pedestrian Plan Update (2013)
- ADOT Pedestrian Safety Action Plan (2017)
- ADOT Five-Year Transportation Facilities Construction Program (2018 – 2022)
- ADOT Climbing and Passing Lane Prioritization Study (2015)
- ADOT Arizona Key Commerce Corridors (2014)
- ADOT Arizona Multimodal Freight Analysis Study (2009)
- ADOT Arizona Ports of Entry Study (2013)
- ADOT Arizona State Airport Systems Plan (2008)
- ADOT Arizona State Freight Plan (2016)
- ADOT Arizona State Rail Plan (2011)
- AGFD Arizona State Wildlife Action Plan (2012) / Arizona Wildlife Linkages Assessment
- ADOT Arizona Statewide Dynamic Message Sign Master Plan (2011)
- ADOT Arizona Statewide Rail Framework Study (2010)
- ADOT Arizona Statewide Rest Area Study (2011)
- ADOT Arizona Statewide Shoulders Study (2015)
- ADOT Arizona Strategic Highway Safety Plan (2014)
- ADOT Arizona Roadway Departure Safety Implementation Plan (RDSIP) (2014)
- ADOT AASHTO U.S. Bicycle Route System (2015)
- ADOT Low Volume State Routes Study (2017)
- ADOT Statewide Transportation Planning Framework - Building a Quality Arizona (BQAZ) (2010)
- ADOT Eastern Arizona Framework Study (2009)
- ADOT What Moves You Arizona? Long-Range Transportation Plan (2010-2035)

Regional Planning Studies

- City of Williams General Plan 2013 Update (2013)
- Coconino County Comprehensive Plan (2003)
- Final Feasibility Report SR 64: I-40 to Moqui (2006)
- NACOG, Regional Transportation Improvement Program (2017)
- Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)

Design Concept Reports and Project Assessments

- SR 64: I-40 to Bureau Camp – Project Assessment (2007)
- SR 64: Valle – Project Assessment (2009)
- SR 64: Williams – Materials Design Review (2010)

Summary of Prior Recommendations

Various studies and plans, including several DCRs and PAs, have recommended improvements to the SR 64 corridor as shown in **Table 3** and **Figure 4**. They include, but are not limited to:

- Widening the roadway along the corridor
- Safety shoulder improvements at the following locations
  - MP 196 – 204 Tier 1 Priority
  - MP 212 – 214 Tier 1 Priority
  - MP 216 – 232 Tier 1 Priority
  - MP 204 – 212, 214 – 216 Tier 2 Priority
- Climbing and passing lanes have been recommended throughout the SR 64 corridor based on the Climbing and Passing Lane Prioritization Study
- New underpasses and overpasses have been recommended throughout the SR 64 corridor based on the Wildlife Accident Reduction Study and Monitoring.

Table 3: Corridor Recommendations from Previous Studies

Map Key Ref. #	Begin MP	End MP	Length (miles)	Project Description	Investment Category (Preservation [P], Modernization[M], Expansion [E])			Status of Recommendation			Name of Study
					P	M	E	Program Year	Project No.	Environmental Documentation (Y/N)?	
1	185	237	52.0	Roadway Widening (MP 185-237); (MP 212.45-214.39) from 2 to 5 lanes; curb/gutter replacement; new roadway markings depressed curb and concrete apron at driveways; concrete median north and south of US 180 intersection, south of Highgrove Road intersection and south of Airport Entrance. New street lights at SR 64/US180 intersection		√		2030	N/A	N	Building and Quality Arizona (BQAZ) (2010)
2	185	237	52.0	Designate SR 64 as a part of U.S. Bicycle Route 79		√		-	N/A	N	ADOT AASHTO U.S. Bicycle Route System (2015)
3	185	236	51.0	Potential rest area between Tusayan and Williams (marked as spot between MP 185 and MP 236)		√		-	N/A	N	Arizona Statewide Rest Area Study (2011)
4	186	198.2	12.2	8-foot ungulate-proof (wildlife) fencing along ROW		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012) State Route 64: I-40 to Moqui Feasibility Report (2006) SR 64: Jct I-40 to Bureau Camp Right of Way Fence – PA (2006)
5	187.3	187.3	0.0	Retrofitting Cataract Canyon Bridge as an underpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
6	187.80	225.7	37.9	Passing/Climbing Lanes: • EB Passing/Climbing (MP 196 -198) - Tier 2 • WB Climbing Lane (MP 199 -197) – Tier 2 • EB/WB Passing (MP 204 - 201) -Tier 2 • EB Passing (224.4-225.7) - Tier 2 • EB Passing (MP 211-218)-Tier 3;			√	-	~~N/A~~	N	State Route 64: I-40 to Moqui Feasibility Report (2006) ADOT Climbing and Passing Lane Prioritization Study (2015)

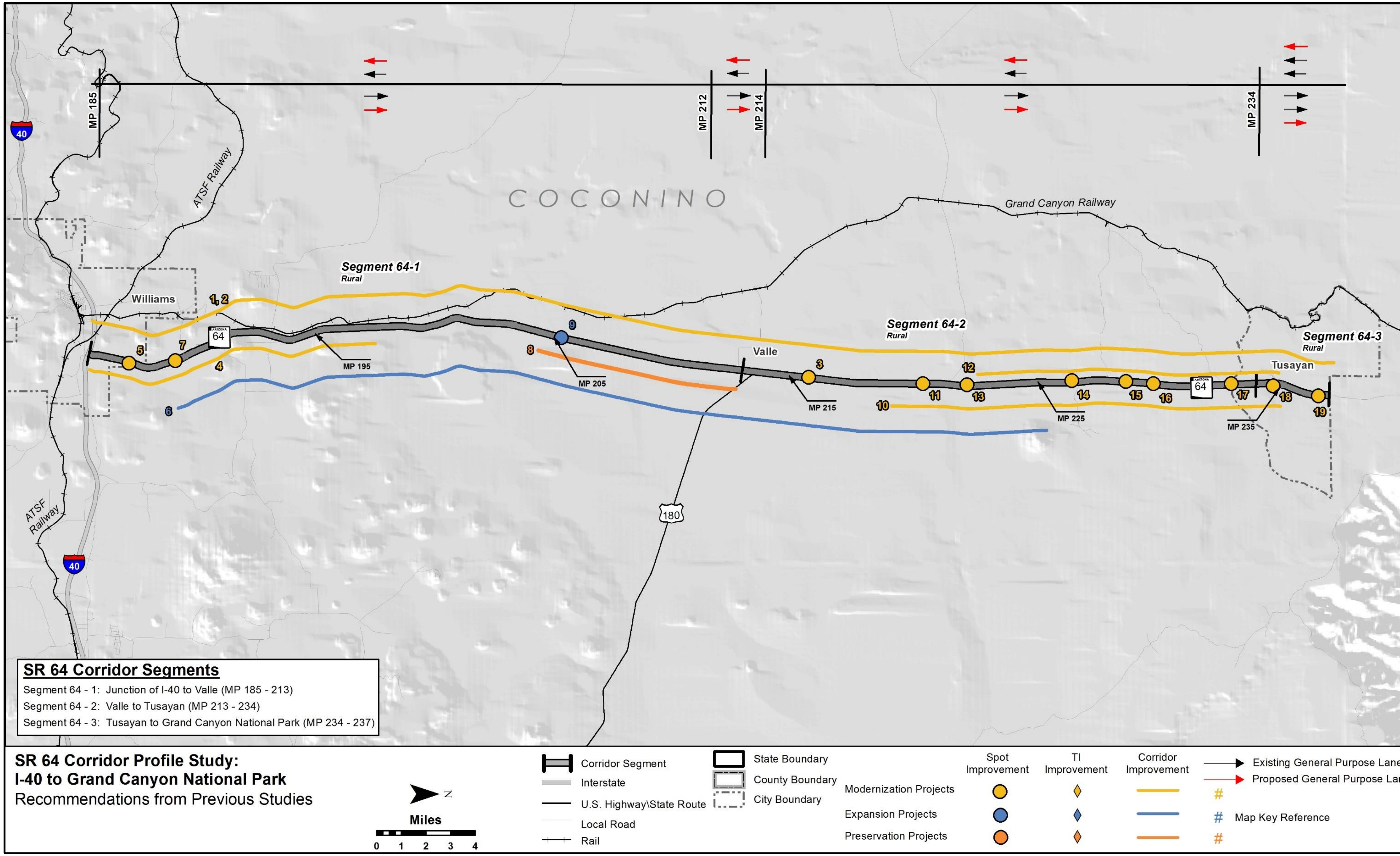
Table 3: Corridor Recommendations from Previous Studies (continued)

Map Key Ref. #	Begin MP	End MP	Length (miles)	Project Description	Investment Category (Preservation [P], Modernization[M], Expansion [E])			Status of Recommendation			Name of Study
					P	M	E	Program Year	Project No.	Environmental Documentation (Y/N)?	
7	189.2	189.2	0.0	New Overpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
8	205	213	8.0	Pavement Preservation: Pipeline Rd-Airpark	√			2021	N/A	N	ADOT Five-Year Transportation Facilities Construction Program ~~2018~~ – 2022
9	205.0	205.5	0.5	New Overpass			√	-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
10	219	235	16.0	Grand Canyon National Park – Construct Right of Way Fence		√		2018	N/A	N	ADOT Five-Year Transportation Facilities Construction Program ~~2018~~ – 2022
11	220.0	220.59	0.6	New Overpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
12	222.3	234.4	12.1	8-foot ungulate-proof (wildlife) fencing		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
13	222.3	222.3	0.0	New Overpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
14	226.6	226.6	0.0	New Underpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
15	228.8	228.8	0.0	New Underpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
16	229.7	229.7	0.0	New Underpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)

Table 3: Corridor Recommendations from Previous Studies (continued)

Map Key Ref. #	Begin MP	End MP	Length (miles)	Project Description	Investment Category (Preservation [P], Modernization [M], Expansion [E])			Status of Recommendation			Name of Study
					P	M	E	Program Year	Project No.	Environmental Documentation (Y/N)?	
17	233.0	233.0	0.0	New Underpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
18	235.5	235.5	0.0	Electrified barrier across highway		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)
19	236.8	236.8	0.0	New Underpass		√		-	N/A	N	Wildlife Accident Reduction Study and Monitoring: SR 64 (2012)

Figure 4: Corridor Recommendations from Previous Studies



2.0 CORRIDOR PERFORMANCE

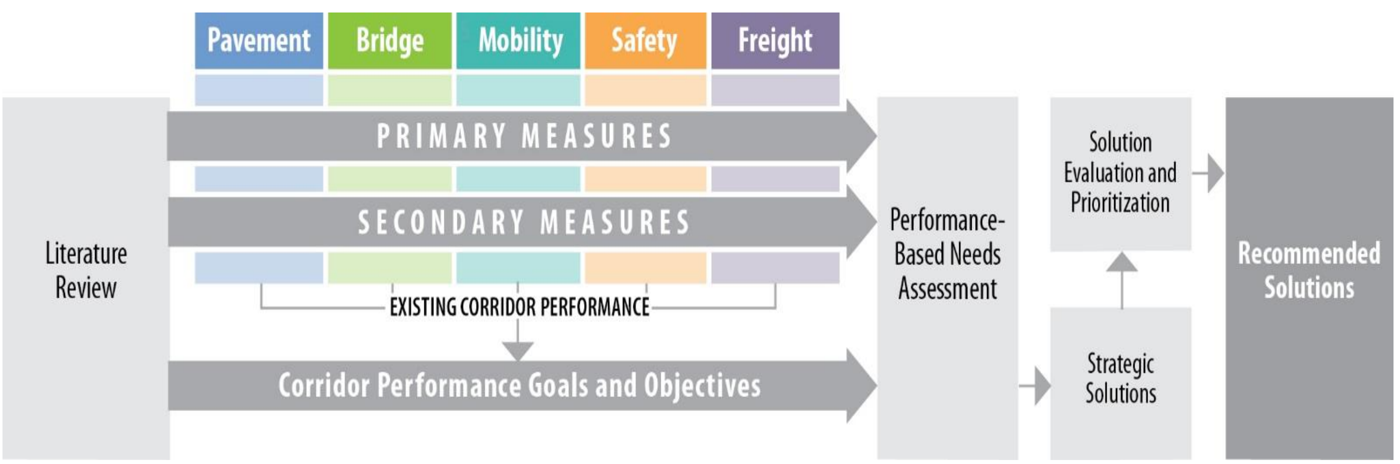
This chapter describes the evaluation of the existing performance of the SR 64 corridor. A series of performance measures are used to assess the corridor. The results of the performance evaluation are then used to define corridor needs relative to the long-term goals and objectives for the corridor.

2.1 Corridor Performance Framework

This study employs a performance-based process to define baseline corridor performance, diagnose corridor needs, develop corridor solutions, and prioritize strategic corridor investments. In support of this objective, a framework for the performance-based process was developed through a collaborative process involving ADOT and the CPS consultant teams.

Figure 5 illustrates the performance framework, which includes a two-tiered system of performance measures (primary and secondary) to evaluate baseline performance. The primary measures in each of five performance areas are used to define the overall health of the corridor, while the secondary measures identify locations that warrant further diagnostic investigation to delineate needs. Needs are defined as the difference between baseline corridor performance and established performance objectives.

Figure 5: Corridor Profile Performance Framework



The following five performance areas guide the performance-based corridor analyses:

- Pavement
- Bridge
- Mobility
- Safety
- Freight

These performance areas reflect national performance goals stated in *Moving Ahead for Progress in the 21st Century* (MAP-21):

- Safety: To achieve a significant reduction in traffic fatalities and serious injuries on all public roads
- Infrastructure Condition: To maintain the highway infrastructure asset system in a state of good repair
- Congestion Reduction: To achieve a significant reduction in congestion on the National Highway System
- System Reliability: To improve the efficiency of the surface transportation system
- Freight Movement and Economic Vitality: To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development
- Environmental Sustainability: To enhance the performance of the transportation system while protecting and enhancing the natural environment
- Reduced Project Delivery Delays: To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion

The MAP-21 performance goals were considered in the development of ADOT's P2P process, which integrates transportation planning with capital improvement programming and project delivery. Because the P2P program requires the preparation of annual transportation system performance reports using the five performance areas adopted for the CPS, consistency is achieved in the performance measures used for various ADOT analysis processes.

The performance measures include five primary measures: Pavement Index, Bridge Index, Mobility Index, Safety Index, and Freight Index. Additionally, a set of secondary performance measures provides for a more detailed analysis of corridor performance.

Each of the primary and secondary performance measures is comprised of one or more quantifiable indicators. A three-level scale was developed to standardize the performance scale across the five performance areas, with numerical thresholds specific to each performance measure:

Good/Above Average Performance	– Rating is above the identified desirable/average range
Fair/Average Performance	– Rating is within the identified desirable/average range
Poor/Below Average Performance	– Rating is below the identified desirable/average range

Table 4 provides the complete list of primary and secondary performance measures for each of the five performance areas.

Table 4: Corridor Performance Measures

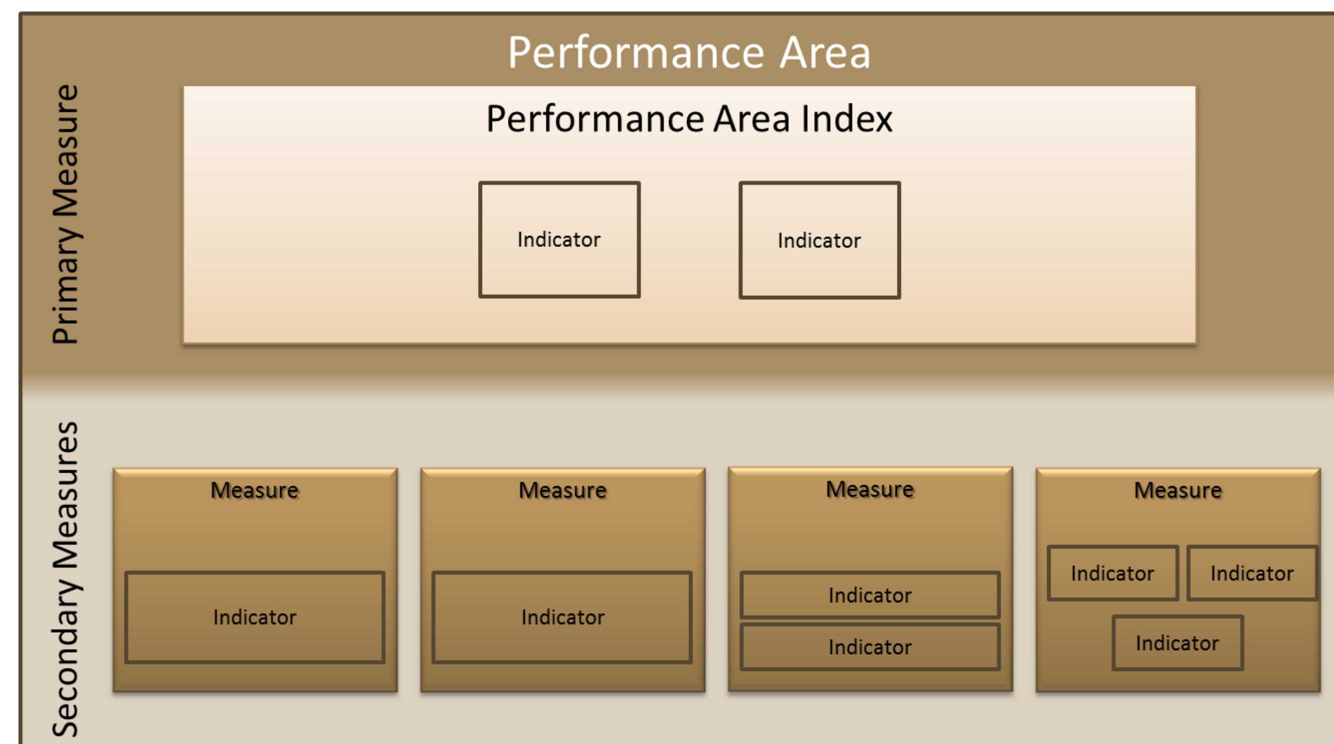
Performance Area	Primary Measure	Secondary Measures
Pavement	**Pavement Index** Based on a combination of International Roughness Index and cracking	• Directional Pavement Serviceability • Pavement Failure • Pavement Hot Spots
Bridge	**Bridge Index** Based on lowest of deck, substructure, superstructure and structural evaluation rating	• Bridge Sufficiency • Functionally Obsolete Bridges • Bridge Rating • Bridge Hot Spots
Mobility	**Mobility Index** Based on combination of existing and future daily volume-to-capacity ratios	• Future Congestion • Peak Congestion • Travel Time Reliability • Multimodal Opportunities
Safety	**Safety Index** Based on frequency of fatal and incapacitating injury crashes	• Directional Safety Index • Strategic Highway Safety Plan Emphasis Areas • Crash Unit Types • Safety Hot Spots
Freight	**Freight Index** Based on bi-directional truck planning time index	• Recurring Delay • Non-Recurring Delay • Closure Duration • Bridge Vertical Clearance • Bridge Vertical Clearance Hot Spots

The general template for each performance area is illustrated in **Figure 6**.

The guidelines for performance measure development are:

- Indicators and performance measures for each performance area should be developed for relatively homogeneous corridor segments
- Performance measures for each performance area should be tiered, consisting of primary measure(s) and secondary measure(s)
- Primary and secondary measures should assist in identifying those corridor segments that warrant in-depth diagnostic analyses to identify performance-based needs and a range of corrective actions known as solution sets
- One or more primary performance measures should be used to develop a Performance Index to communicate the overall health of a corridor and its segments for each performance area; the Performance Index should be a single numerical index that is quantifiable, repeatable, scalable, and capable of being mapped; primary performance measures should be transformed into a Performance Index using mathematical or statistical methods to combine one or more data fields from an available ADOT database
- One or more secondary performance measure indicators should be used to provide additional details to define corridor locations that warrant further diagnostic analysis; secondary performance measures may include the individual indicators used to calculate the Performance Index and/or “hot spot” features

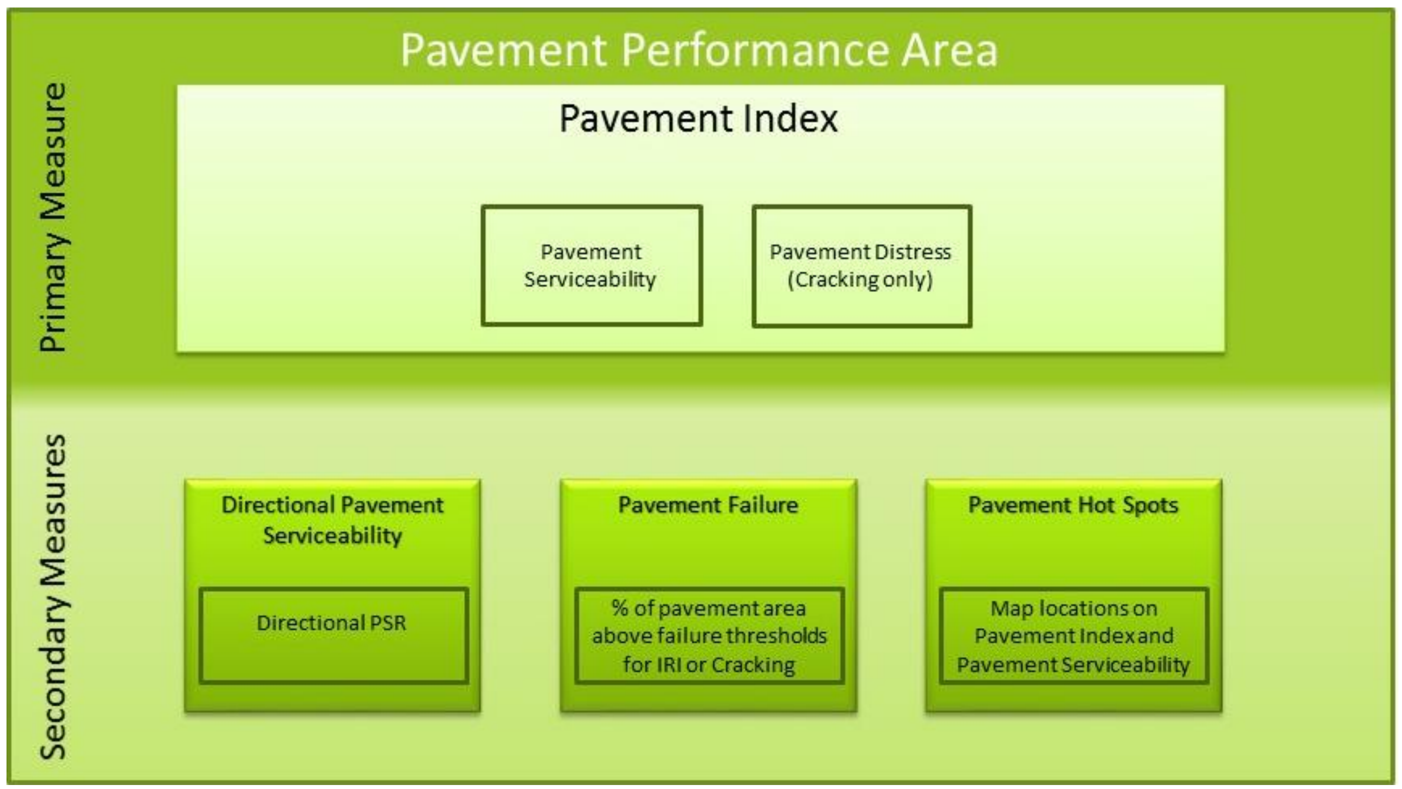
Figure 6: Performance Area Template



2.2 Pavement Performance Area

The Pavement performance area consists of a primary measure (Pavement Index) and three secondary measures, as shown in **Figure 7**. These measures assess the condition of the existing pavement along the SR 64 corridor. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C**.

Figure 7: Pavement Performance Measures



Primary Pavement Index

The Pavement Index is calculated using two pavement condition ratings: the Pavement Serviceability Rating (PSR) and the Pavement Distress Index (PDI).

The PSR is extracted from the International Roughness Index (IRI), a measurement of pavement roughness based on field-measured longitudinal roadway profiles. The PDI is extracted from the Cracking Rating (CR), a field-measured sample from each mile of highway.

Both the PSR and PDI use a 0 to 5 scale with 0 representing the lowest performance and 5 representing the highest. The Pavement Index for each segment is a weighted average of the directional ratings based on the number of travel lanes. Therefore, the condition of a section with more travel lanes will have a greater influence on the resulting segment Pavement Index than the condition of a section with fewer travel lanes.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the Pavement performance area, the relevant operating environments are designated as interstate and non-interstate segments. For the SR 64 corridor, the following operating environment was identified:

- Non-interstate: all segments

Secondary Pavement Measures

Three secondary measures provide an in-depth evaluation of the different characteristics of pavement performance.

Directional Pavement Serviceability

- Weighted average (based on number of lanes) of the PSR for the pavement in each direction of travel

Pavement Failure

- Percentage of pavement area rated above failure thresholds for IRI or Cracking

Pavement Hot Spots

- A Pavement "hot spot" exists where a given one-mile section of roadway rates as being in "poor" condition
- Highlights problem areas that may be under-represented in a segment average; this measure is recorded and mapped, but not included in the Pavement performance area rating calculations

Pavement Performance Results

The Pavement Index provides a high-level assessment of the pavement condition for the corridor and for each segment. The three secondary measures provide more detailed information to assess pavement performance.

Based on the results of this analysis, the following observations were made:

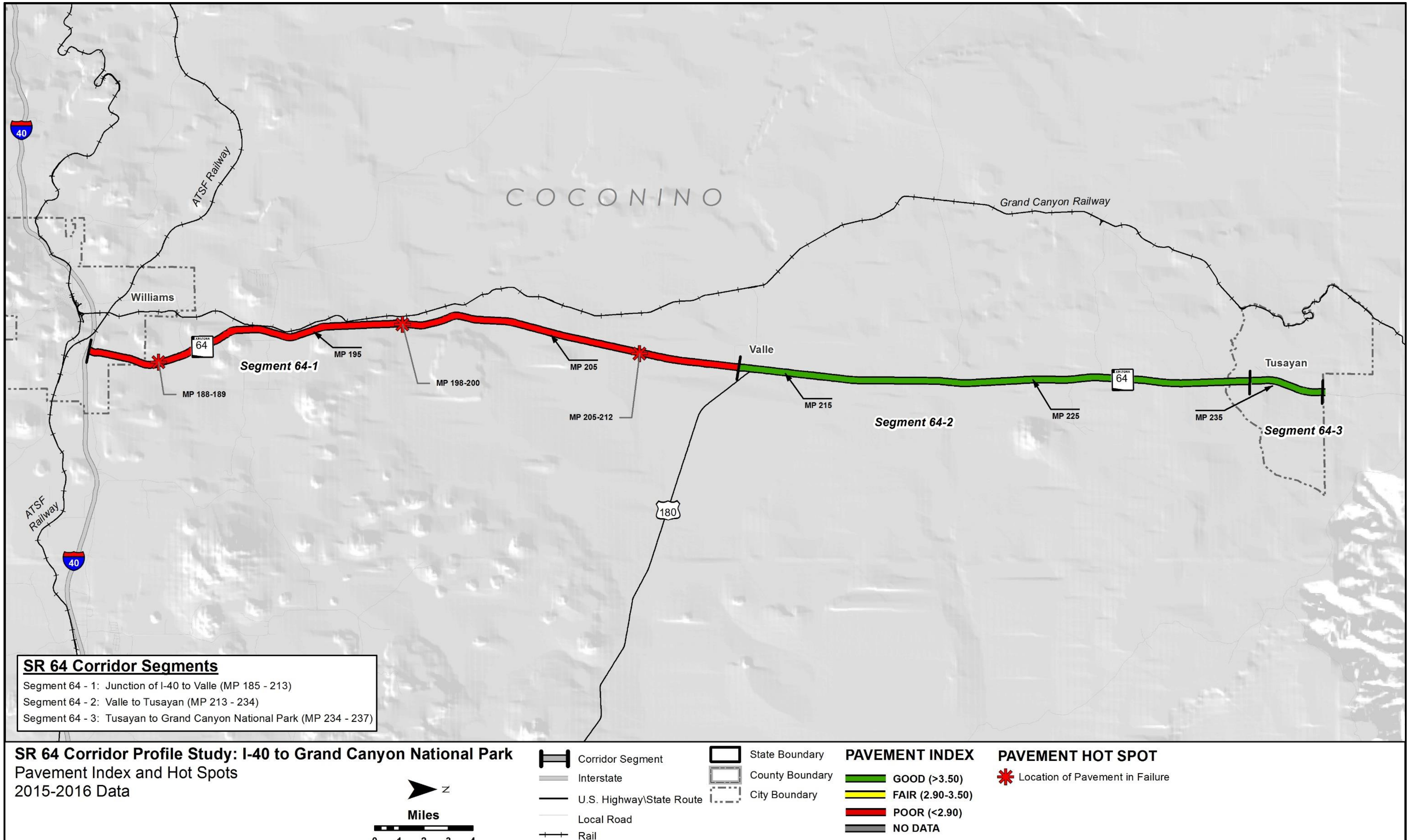
- The weighted average of the Pavement Index shows "fair" overall performance for the SR 64 corridor
- According to the Pavement Index, Segment 64-1 is in "poor" condition and Segments 64-2 and 64-3 are in "good" condition
- Segment 64-1 has "poor" % Pavement Area Failure ratings
- Pavement hot spots along the corridor include:
  - Segment 64-1 MP 188-189, 198-200, 205-212

Table 5 summarizes the Pavement performance results for the SR 64 corridor. **Figure 8** illustrates the primary Pavement Index performance and locations of Pavement hot spots along the SR 64 corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 4: Pavement Performance

Segment #	Segment Length (miles)	Pavement Index	Directional PSR		% Area Failure
			EB	WB	
64-1	28	2.88	3.09		38.0%
64-2	21	3.60	3.50		0.0%
64-3	3	3.69	3.52		0.0%
Weighted Corridor Average		3.22	3.28		20%
SCALES					
Performance Level		**Non-Interstate**			
Good		> 3.50			< 5%
Fair		2.90 - 3.50			5% - 20%
Poor		< 2.90			> 20%

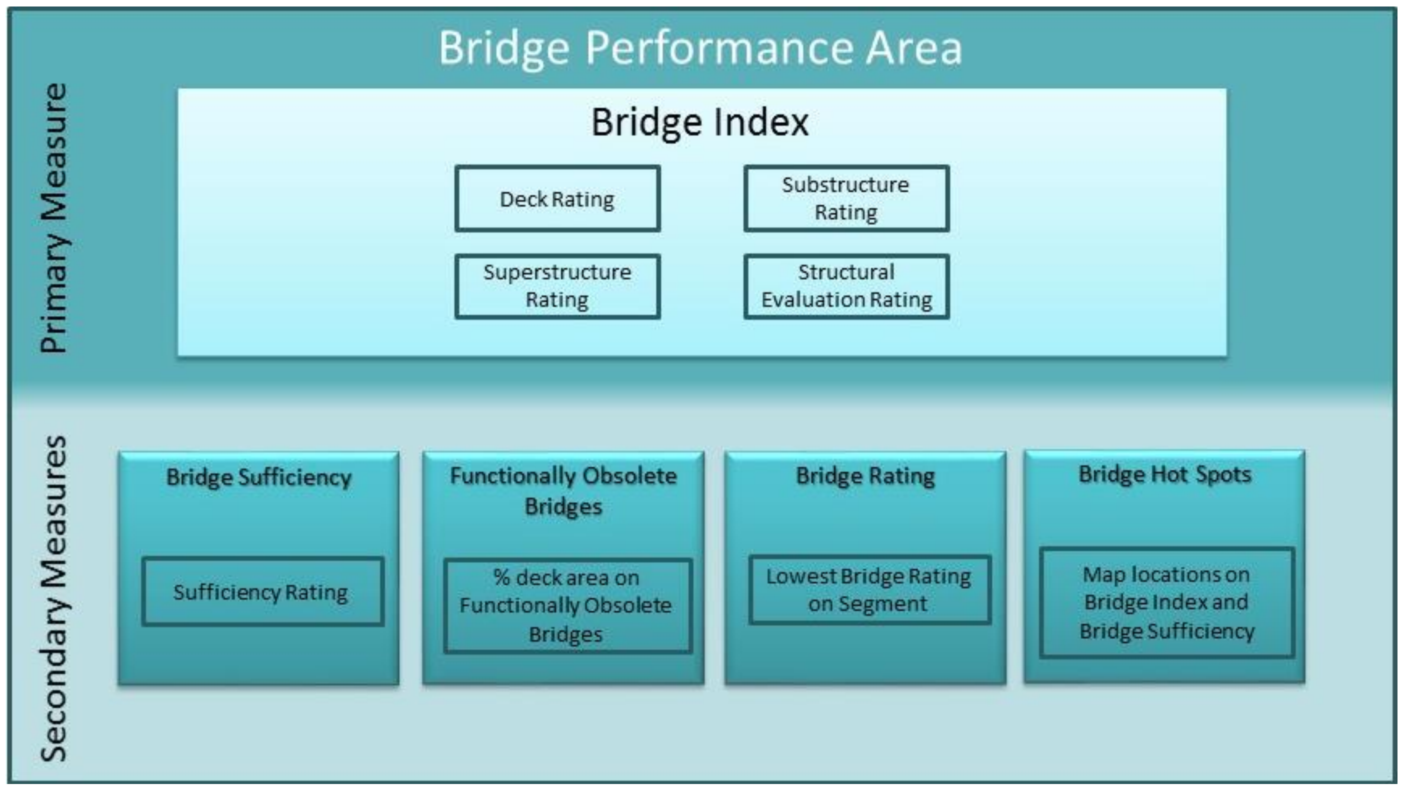
Figure 8: Pavement Performance



2.3 Bridge Performance Area

The Bridge performance area consists of a primary measure (Bridge Index) and four secondary measures, as shown in **Figure 9**. These measures assess the condition of the existing bridges along the SR 64 corridor. Only bridges that carry mainline traffic or bridges that cross the mainline are included in the calculation. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C**.

Figure 9: Bridge Performance Measures



Primary Bridge Index

The Bridge Index is calculated based on the use of four different bridge condition ratings from the ADOT Bridge Database, also known as the Arizona Bridge Information and Storage System (ABISS). The four ratings are the Deck Rating, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating. These ratings are based on inspection reports and establish the structural adequacy of each bridge. The performance of each individual bridge is established by using the lowest of these four ratings. The use of these ratings, and the use of the lowest rating, is consistent with the approach used by the ADOT Bridge Group to assess the need for bridge rehabilitation. The Bridge Index is calculated as a weighted average for each segment based on deck area.

Secondary Bridge Measures

Four secondary measures provide an in-depth evaluation of the characteristics of each bridge:

Bridge Sufficiency

- Multipart rating includes structural adequacy and safety factors as well as functional aspects such as traffic volume and length of detour
- Rates the structural and functional sufficiency of each bridge on a 100-point scale

Functionally Obsolete Bridges

- Percentage of total deck area in a segment that is on functionally obsolete bridges
- Identifies bridges that no longer meet standards for current traffic volumes, lane width, shoulder width, or bridge rails
- A bridge that is functionally obsolete may still be structurally sound

Bridge Rating

- The lowest rating of the four bridge condition ratings (substructure, superstructure, deck, and structural evaluation) on each segment
- Identifies lowest performing evaluation factor on each bridge

Bridge Hot Spots

- A Bridge "hot spot" is identified where a given bridge has a bridge rating of 4 or lower or multiple ratings of 5 between the deck, superstructure, and substructure ratings
- Identifies particularly low-performing bridges or those that may decline to low performance in the immediate future

Bridge Performance Results

The Bridge Index provides a high-level assessment of the structural condition of bridges for the corridor and for each segment. The four secondary measures provide more detailed information to assess bridge performance.

Based on the results of this analysis, the following observations were made:

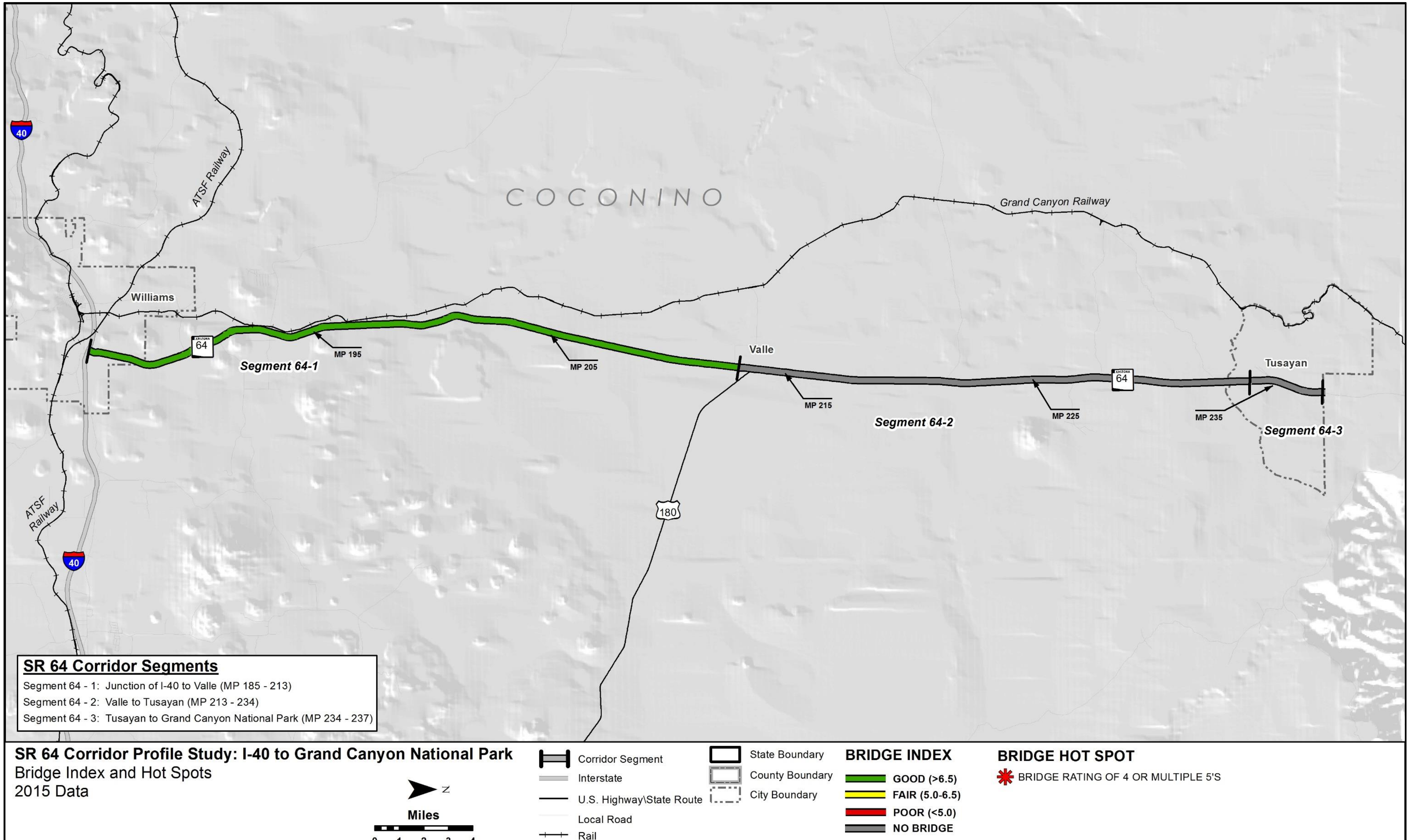
- The weighted average of the Bridge Index shows "good" overall performance for the SR 64 corridor
- Segment 64-1 is the only segment with a bridge and has a "good" Bridge Index rating, a "good" Sufficiency Rating, and a "good" Lowest Bridge Rating
- There are no functionally obsolete bridges or bridge hot spots on the corridor

Table 6 summarizes the Bridge performance results for the SR 64 corridor. **Figure 10** illustrates the primary Bridge Index performance and locations of Bridge hot spots along the SR 64 corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 6: Bridge Performance

Segment #	Segment Length (miles)	# of Bridges	Bridge Index	Sufficiency Rating	% of Deck Area on Functionally Obsolete Bridges	Lowest Bridge Rating
64-1	28	1	7.00	84.60	0.0%	7
64-2	21	0	No Bridges			
64-3	3	0	No Bridges			
Weighted Corridor Average			7.00	84.60	0%	7.00
SCALES						
Performance Level			**All**			
Good			> 6.5	> 80	< 12%	> 6
Fair			5.0 - 6.5	50 - 80	12% - 40%	5 - 6
Poor			< 5.0	< 50	> 40 %	< 5

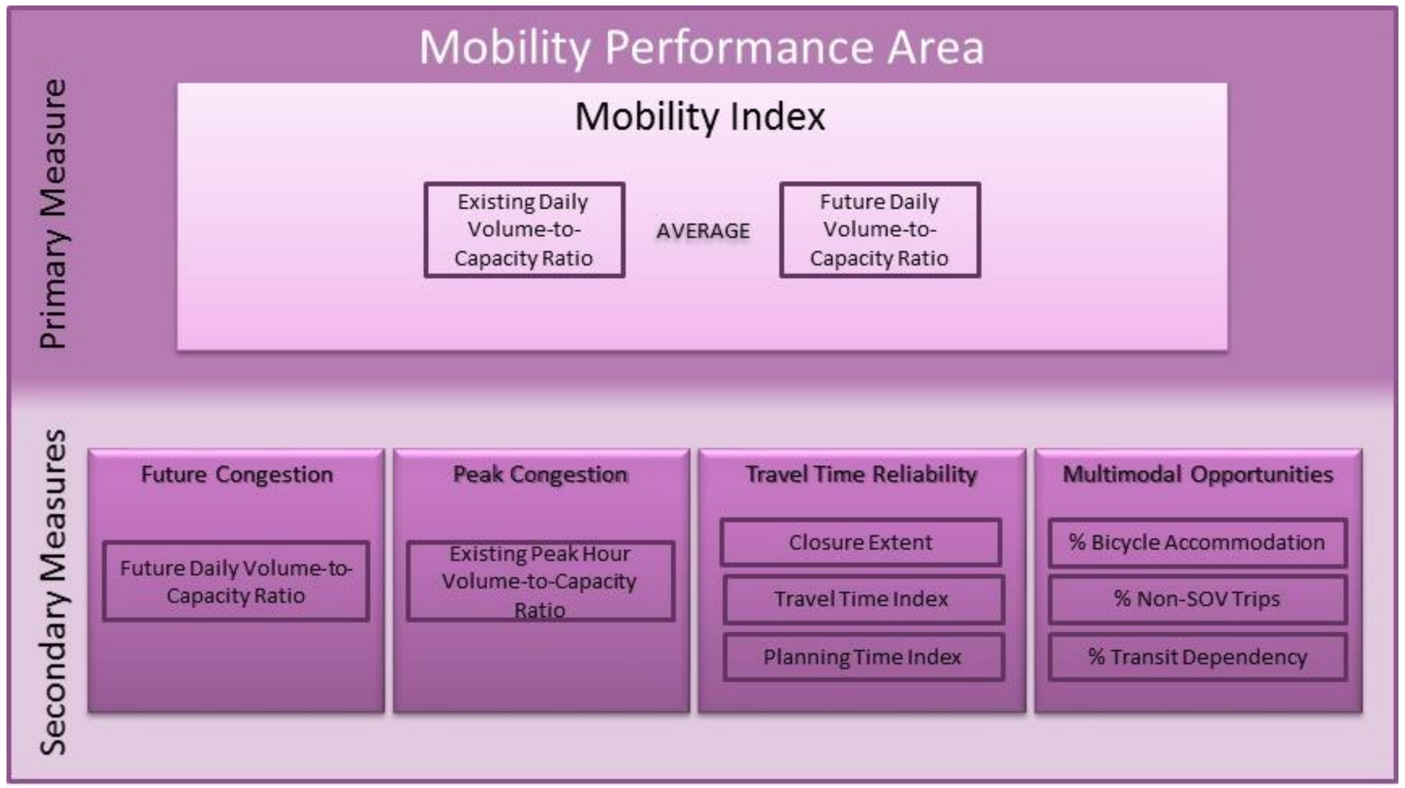
Figure 10: Bridge Performance



2.4 Mobility Performance Area

The Mobility performance area consists of a primary measure (Mobility Index) and four secondary measures, as shown in **Figure 11**. These measures assess the condition of existing mobility along the SR 64 corridor. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C**.

Figure 11: Mobility Performance Measures



Primary Mobility Index

The Mobility Index is an average of the existing (2014) daily volume-to-capacity (V/C) ratio and the future (2035 AZTDM) daily V/C ratio for each segment of the corridor. The V/C ratio is an indicator of the level of congestion. This measure compares the average annual daily traffic (AADT) volume to the capacity of the corridor segment as defined by the service volume for level of service (LOS) E. By using the average of the existing and future year daily volumes, this index measures the level of daily congestion projected to occur in approximately ten years (2025) if no capacity improvements are made to the corridor.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the Mobility performance area, the relevant operating environments are urban vs. rural setting and interrupted flow (e.g., signalized at-grade intersections are present) vs. uninterrupted flow (e.g., controlled access grade-separated conditions such as a freeway or interstate highway). For the SR 64 corridor, the following operating environments were identified:

- Rural Uninterrupted Flow: Segments 64-1 and 64-2
- Rural Interrupted Flow: Segment 64-3

Secondary Mobility Measures

Four secondary measures provide an in-depth evaluation of operational characteristics of the corridor:

Future Congestion – Future Daily V/C

- The future (2035 AZTDM) daily V/C ratio; this measure is the same value used in the calculation of the Mobility Index
- Provides a measure of future congestion if no capacity improvements are made to the corridor

Peak Congestion – Existing Peak Hour V/C

- The peak hour V/C ratio for each direction of travel
- Provides a measure of existing peak hour congestion during typical weekdays

Travel Time Reliability– Three separate travel time reliability indicators together provide a comprehensive picture of how much time may be required to travel within the corridor:

- Closure Extent:
  - The average number of instances a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel; a weighted average was applied to each closure that takes into account the distance over which the closure occurs
  - Closures related to crashes, weather, or other incidents are a significant contributor to non-recurring delays; construction-related closures were excluded from the analysis
- Directional Travel Time Index (TTI):
  - The ratio of the average peak period travel time to the free-flow travel time (based on the posted speed limit) in a given direction
  - The TTI recognizes the delay potential from recurring congestion during peak periods; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics
- Directional Planning Time Index (PTI):
  - The ratio of the 95th percentile travel time to the free-flow travel time (based on the posted speed limit) in a given direction
  - The PTI recognizes the delay potential from non-recurring delays such as traffic crashes, weather, or other incidents; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics

    - The PTI indicates the amount of time in addition to the typical travel time that should be allocated to make an on-time trip 95% of the time in a given direction

Multimodal Opportunities – Three multimodal opportunity indicators reflect the characteristics of the corridor that promote alternate modes to the single occupancy vehicle (SOV) for trips along the corridor:

- % Bicycle Accommodation:
    - Percentage of the segment that accommodates bicycle travel; bicycle accommodation on the roadway or on shoulders varies depending on traffic volumes, speed limits, and surface type
    - Encouraging bicycle travel has the potential to reduce automobile travel, especially on non-interstate highways
- % Non-SOV Trips:
    - The percentage of trips (less than 50 miles in length) by non-SOVs
    - The percentage of non-SOV trips in a corridor gives an indication of travel patterns along a section of roadway that could benefit from additional multimodal options
- % Transit Dependency:
    - The percentage of households that have zero or one automobile and households where the total income level is below the federally defined poverty level
    - Used to track the level of need among those who are considered transit dependent and more likely to utilize transit if it is available

Mobility Performance Results

The Mobility Index provides a high-level assessment of mobility conditions for the corridor and for each segment. The four secondary measures provide more detailed information to assess mobility performance.

Based on the results of this analysis, the following observations were made:

- The weighted average of the Mobility Index shows “good” overall performance for the SR 64 corridor
- During the existing peak hour, traffic operations are “good” for all segments
- All segments are anticipated to have “good” performance in the future, according to the Future Daily V/C performance indicator
- Segments 64-1 and 64-2 have “fair” performance in the Closure Extent performance indicator for EB travel; all other segments have “good” performance
- The TTI performance indicator shows that all segments on the SR 64 corridor performance at “fair” or “good” performance levels
- The PTI performance indicator shows many of the SR 64 segments, both EB and WB, have “fair” or “poor” performance in terms of reliability
- All segments of SR 64 show “poor” or “fair” performance for non-SOV trips, indicating single occupant trips are more common
- Segments 64-1 and 64-2 show “poor” performance in % Bicycle Accommodation, indicating narrow shoulders, with “good” performance for Segment 64-3.

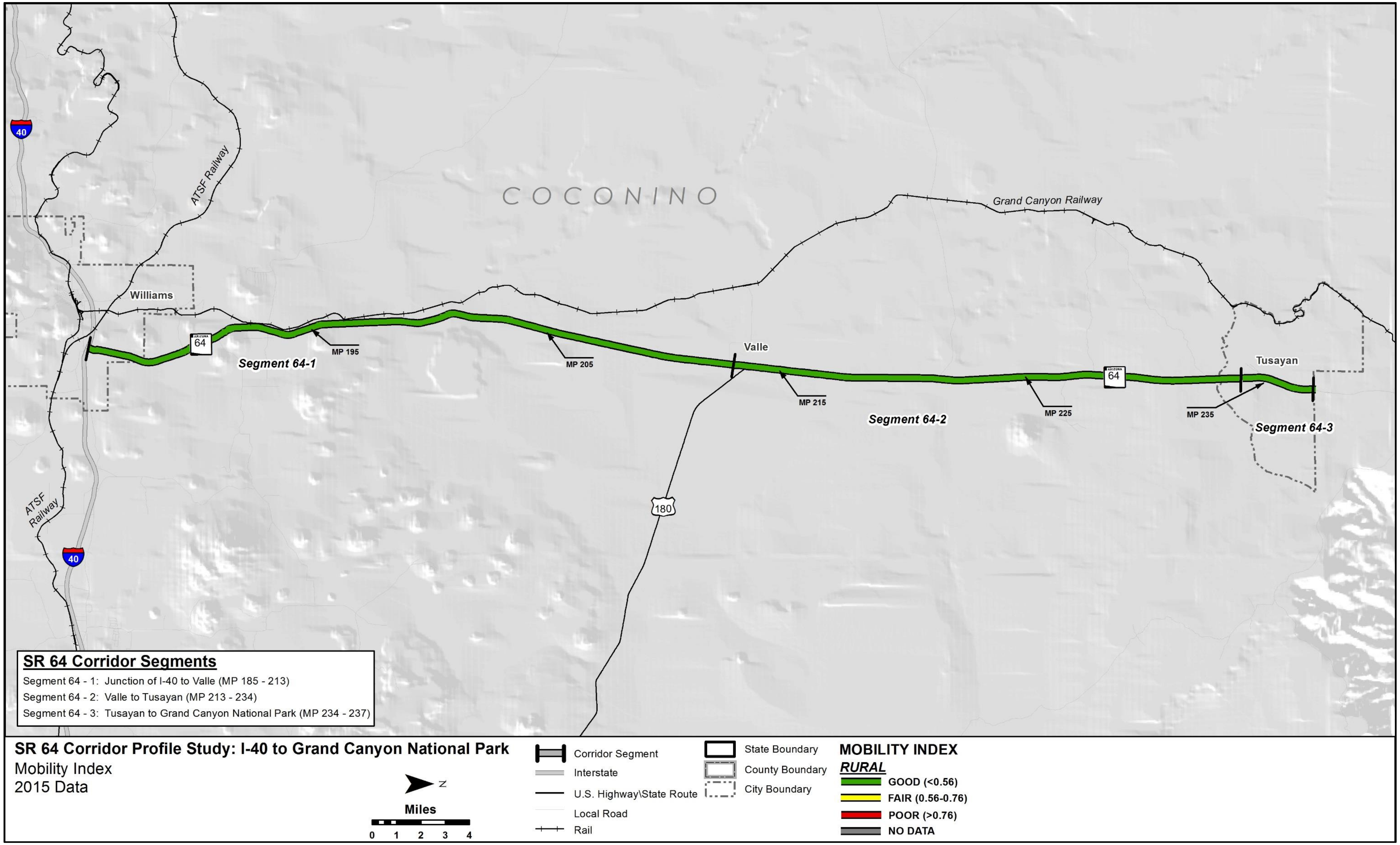
Table 7 summarizes the Mobility performance results for the SR 64 corridor. **Figure 12** illustrates the primary Mobility Index performance along the SR 64 corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 7: Mobility Performance

Segment #	Segment Length (miles)	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent (instances/milepost/year/mile)		Directional TTI (all vehicles)		Directional PTI (all vehicles)		% Bicycle Accommodation	% Non-Single Occupancy Vehicle (SOV) Trips
				EB	WB	EB	WB	EB	WB	EB	WB		
64-1[2^]	28	0.22	0.22	0.21	0.21	0.33	0.03	1.01	1.06	1.27	1.59	5%	13.9%
64-2[2^]	21	0.28	0.32	0.28	0.26	0.28	0.01	1.02	1.17	2.03	2.57	4%	16.8%
64-3[2*]	3	0.55	0.65	0.35	0.35	0.20	0.07	1.07	1.16	1.00	2.04	95%	10.6%
Weighted Corridor Average		0.26	0.29	0.25	0.24	0.30	0.02	1.02	1.11	1.56	2.01	9%	15%
SCALES													
Performance Level		**Urban** **Rural**				**All**		**Uninterrupted** **Interrupted**				**All**	
Good		< 0.71[1] < 0.56[2]				< 0.22		< 1.15^ < 1.30*		< 1.30^ < 3.00*		> 90%	> 17%
Fair		0.71 - 0.89[1] 0.56 - 0.76[2]				0.22 – 0.62		1.15 - 1.33^ 1.30 - 2.00*		1.30 - 1.50^ 3.00 - 6.00*		60% - 90%	11% - 17%
Poor		> 0.89[1] > 0.76[2]				> 0.62		> 1.33^ > 2.00*		> 1.50^ > 6.00*		< 60%	< 11%

[1]Urban Operating Environment
[2]Rural Operating Environment
^Uninterrupted Flow Facility
*Interrupted Flow Facility

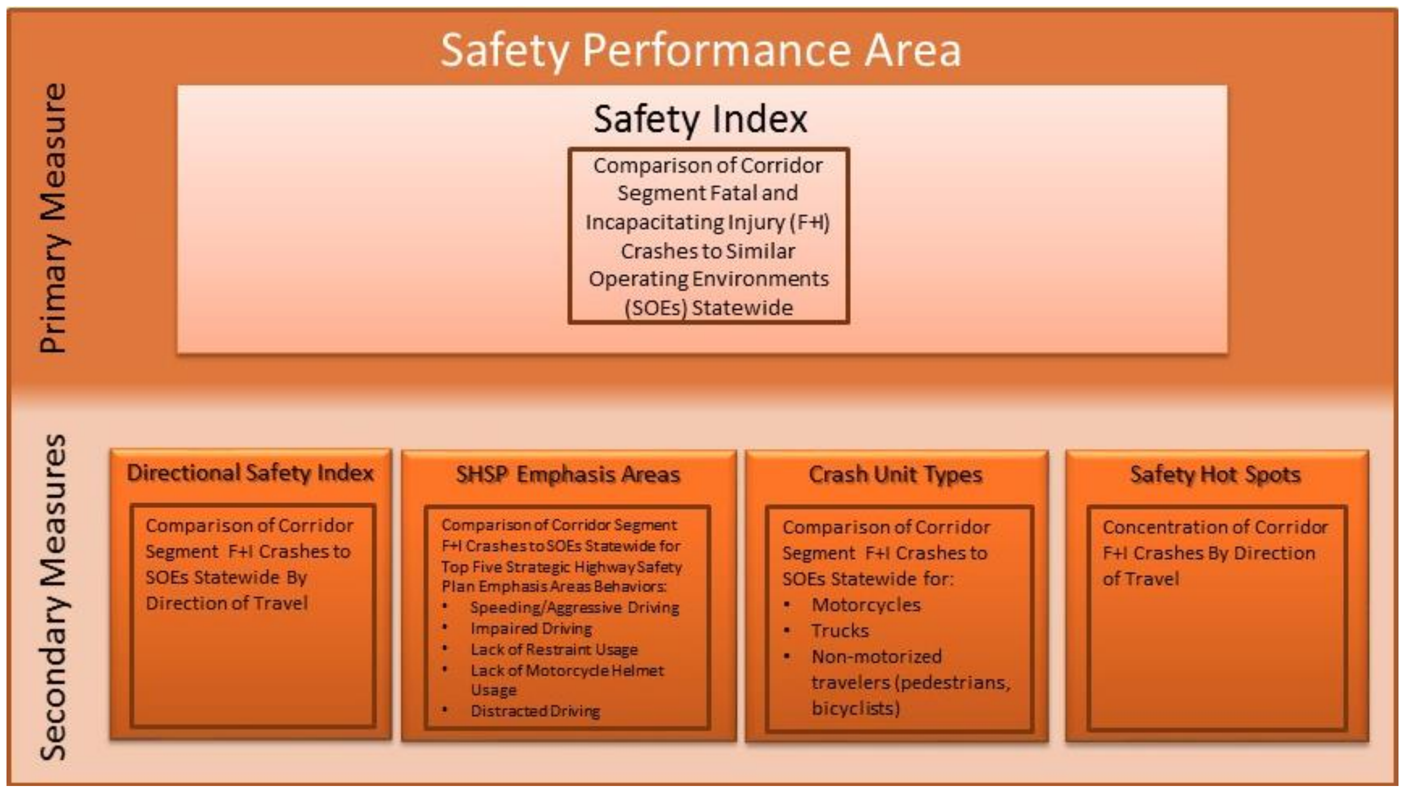
Figure 12: Mobility Performance



2.5 Safety Performance Area

The Safety performance area consists of a primary measure (Safety Index) and four secondary measures, as illustrated in **Figure 13**. All measures relate to crashes that result in fatal and incapacitating injuries, as these types of crashes are the emphasis of the ADOT Strategic Highway Safety Plan (SHSP), FHWA, and MAP-21. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C.**

Figure 13: Safety Performance Measures



Primary Safety Index

The Safety Index is based on the bi-directional frequency and rate of fatal and incapacitating injury crashes, the relative cost of those types of crashes, and crash occurrences on similar roadways in Arizona. According to ADOT's 2010 Highway Safety Improvement Program Manual, fatal crashes have an estimated cost that is 14.5 times the estimated cost of incapacitating injury crashes ($5.8 million compared to $400,000).

Each corridor segment is rated on a scale by comparing the segment score with the average statewide score for similar operating environments. Because crash frequencies and rates vary depending on the operating environment of a particular roadway, statewide values were developed for similar operating environments defined by functional classification, urban vs. rural setting, number of travel lanes, and traffic volumes. For the SR 64 corridor, the following operating environments were identified:

- 2 or 3 lane Undivided Highway: Segments 64-1 and 64-2
- 4 or 5 Lane Undivided Highway: Segment 64-3

Secondary Safety Measures

Four secondary measures provide an in-depth evaluation of the different characteristics of safety performance:

Directional Safety Index

- This measure is based on the directional frequency and rate of fatal and incapacitating injury crashes

SHSP Emphasis Areas

ADOT's 2014 SHSP identified several emphasis areas for reducing fatal and incapacitating injury crashes. This measure compared rates of crashes in the top five SHSP emphasis areas to other corridors with a similar operating environment. The top five SHSP emphasis areas related to the following driver behaviors:

- Speeding and aggressive driving
- Impaired driving
- Lack of restraint usage
- Lack of motorcycle helmet usage
- Distracted driving

Crash Unit Types

- The percentage of total fatal and incapacitating injury crashes that involves crash unit types of motorcycles, trucks, or non-motorized travelers is compared to the statewide average on roads with similar operating environments

Safety Hot Spots

- The hot spot analysis identifies abnormally high concentrations of fatal and incapacitating injury crashes along the study corridor by direction of travel

For the Safety Index and the secondary safety measures, any segment that has too small of a sample size to generate statistically reliable performance ratings for a particular performance measure is considered to have "insufficient data" and is excluded from the safety performance evaluation for that particular performance measure.

Safety Performance Results

The Safety Index provides a high-level assessment of safety performance for the corridor and for each segment. The four secondary measures provide more detailed information to assess safety performance.

Based on the results of this analysis, the following observations were made:

- The crash unit type performance measures for crashes involving trucks, motorcycles, and non-motorized travelers as well as for behaviors associated with the SHSP Top 5 Emphasis Areas had insufficient data to generate reliable performance ratings for the SR 64 corridor
- A total of 11 fatal and incapacitating injury crashes occurred along the SR 64 corridor in 2011-2015; of these crashes, 2 were fatal and 9 involved incapacitating injuries
- The weighted average of the Safety Index shows "above average" performance for the SR 64 corridor compared to other segments statewide that have similar operating environments, meaning the corridor generally performs well as it relates to safety
- The Directional Safety Index value for all segments is "above average"

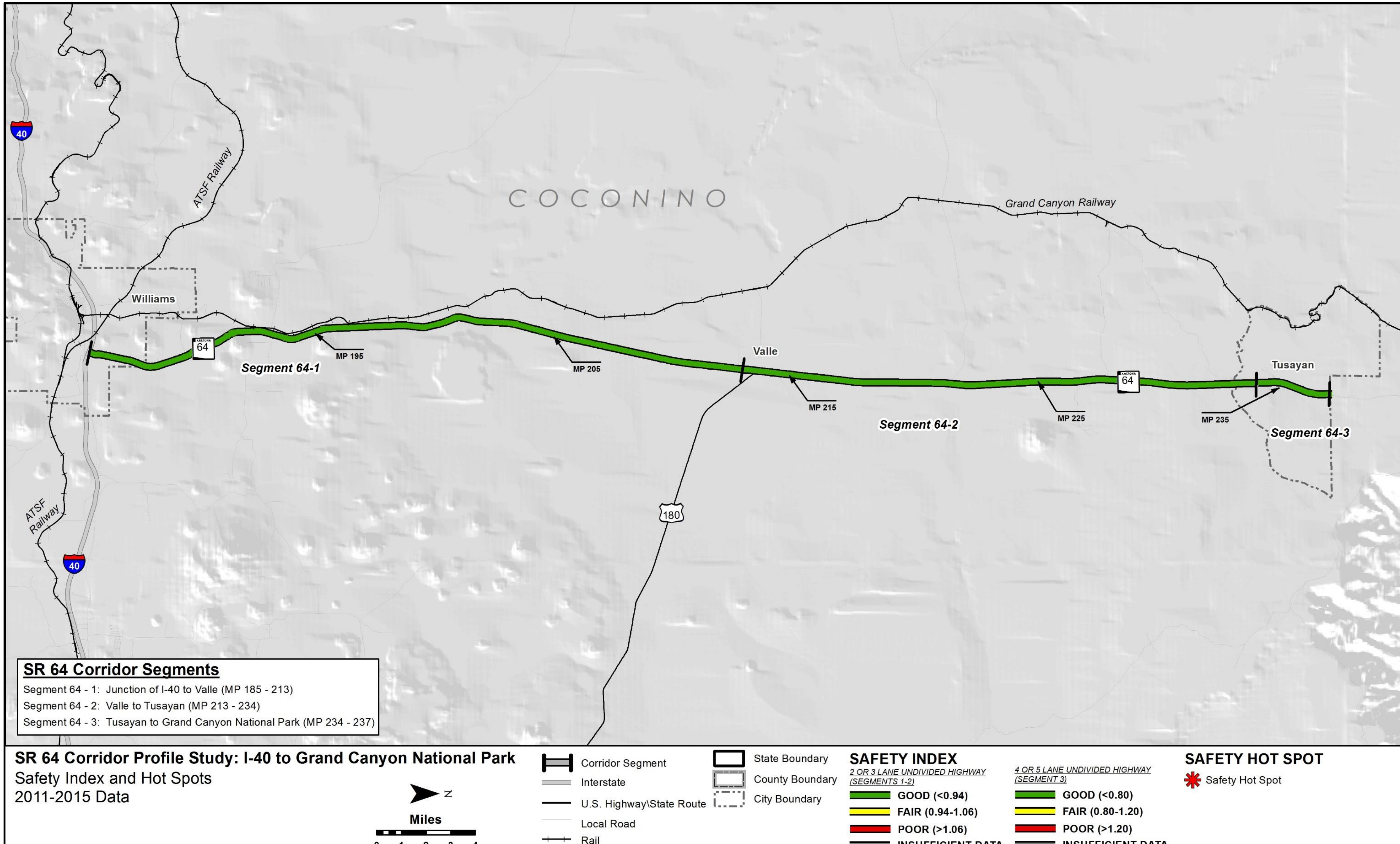
Table 8 summarizes the Safety performance results for the SR 64 corridor. **Figure 14** illustrates the primary Safety Index performance and locations of Safety hot spots along the SR 64 corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 8: Safety Performance

Segment #	Segment Length (miles)	Total Fatal & Incapacitating Injury Crashes (F/I)	Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers
				EB	WB				
64-1[c]	28	1/4	0.27	0.45	0.09	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
64-2[c]	21	1/4	0.36	0.08	0.64	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
64-3[b]	3	0/1	0.08	0.00	0.16	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Weighted Corridor Average			0.30	0.27	0.32	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
SCALES									
Performance Level			**2 or 3 or 4 Lane Divided Highway**						
Above Average			< 0.77			< 44%	< 4%	< 16%	< 2%
Average			0.77 – 1.23			44% - 54%	4% - 7%	16% - 26%	2% - 4%
Below Average			> 1.23			> 54%	> 7%	> 26%	> 4%
Performance Level			**4 or 5 Lane Undivided Highway**						
Above Average			< 0.80			< 42%	< 6%	< 6%	< 5%
Average			0.80 – 1.20			42% - 51%	6% - 10%	6% - 9%	5% - 8%
Below Average			> 1.20			> 51%	> 10%	> 9%	> 8%
Performance Level			**2 or 3 Lane Undivided Highway**						
Above Average			< 0.94			< 51%	< 6%	< 19%	< 5%
Average			0.94 – 1.06			51% - 58%	6% - 10%	19% - 27%	5% - 8%
Below Average			> 1.06			> 58%	> 10%	> 27%	> 8%

[a]2 or 3 or 4 Lane Divided Highway
[b]4 or 5 Lane Undivided Highway
[c]2 or 3 Lane Undivided Highway
Note: "Insufficient Data" indicates there was not enough data available to generate reliable performance ratings.

Figure 14: Safety Performance



2.6 Freight Performance Area

The Freight performance area consists of a single primary measure (Freight Index) and five secondary measures, as illustrated in **Figure 15**. All measures related to the reliability of truck travel as measured by observed truck travel time speed and delays to truck travel from freeway closures or physical restrictions to truck travel. The detailed calculations and equations developed for each measure are available in **Appendix B** and the performance data for this corridor is contained in **Appendix C**.

Figure 15: Freight Performance Measures

Primary Freight Index

The Freight Index is a reliability performance measure based on the PTI for truck travel. The Truck Planning Time Index (TPTI) is the ratio of the 95th percentile truck travel time to the free-flow truck travel time. The TPTI reflects the extra buffer time needed for on-time delivery while accounting for non-recurring delay. Non-recurring delay refers to unexpected or abnormal delay due to closures or restrictions resulting from circumstances such as crashes, inclement weather, and construction activities.

Each corridor segment is rated on a scale with other segments in similar operating environments. Within the Freight performance area, the relevant operating environments are interrupted flow (e.g., signalized at-grade intersections are present) and uninterrupted flow (e.g., controlled access grade-separated conditions such as a freeway or interstate highway).

For the SR 64 corridor, the following operating environments were identified:

- Uninterrupted Flow: Segments 64-1 and 64-2
- Interrupted Flow: Segment 64-3

Secondary Freight Measures

The Freight performance area includes five secondary measures that provide an in-depth evaluation of the different characteristics of freight performance:

Recurring Delay (Directional Truck Travel Time Index [TTTI])

- The ratio of the average peak period truck travel time to the free-flow truck travel time (based on the posted speed limit up to a maximum of 65 miles per hour) in a given direction
- The TTTI recognizes the delay potential from recurring congestion during peak periods; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics

Non-Recurring Delay (Directional TPTI)

- The ratio of the 95th percentile truck travel time to the free-flow truck travel time (based on the posted speed limit up to a maximum of 65 miles per hour) in a given direction
- The TPTI recognizes the delay potential from non-recurring delays such as traffic crashes, weather, or other incidents; different thresholds are applied to uninterrupted flow (freeways) and interrupted flow (non-freeways) to account for flow characteristics
- The TPTI indicates the amount of time in addition to the typical travel time that should be allocated to make an on-time trip 95% of the time in a given direction

Closure Duration

- The average time (in minutes) a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel; a weighted average is applied to each closure that takes into account the distance over which the closure occurs

Bridge Vertical Clearance

- The minimum vertical clearance (in feet) over the travel lanes for underpass structures on each segment

Bridge Vertical Clearance Hot Spots

- A Bridge vertical clearance "hot spot" exists where the underpass vertical clearance over the mainline travel lanes is less than 16.25 feet and no exit/entrance ramps exist to allow vehicles to bypass the low clearance location
- If a location with a vertical clearance less than 16.25 feet can be avoided by using immediately adjacent exit/entrance ramps rather than the mainline, it is not considered a hot spot

Freight Performance Results

The Freight Index provides a high-level assessment of freight mobility for the corridor and for each segment. The five secondary measures provide more detailed information to assess freight performance.

Based on the results of this analysis, the following observations were made:

- The weighted average of the Freight Index shows "poor" overall performance for the SR 64 corridor
- A majority of the segments show either "poor" or "fair" performance for directional TPTI measures, meaning the corridor has "poor" or "fair" travel time reliability in the EB and WB direction due to non-recurring congestion
- All of the segments show "poor" performance in the EB direction and "good" performance in the WB direction in the closure duration performance measure
- No bridge vertical clearance hot spots exist along the SR 64 corridor

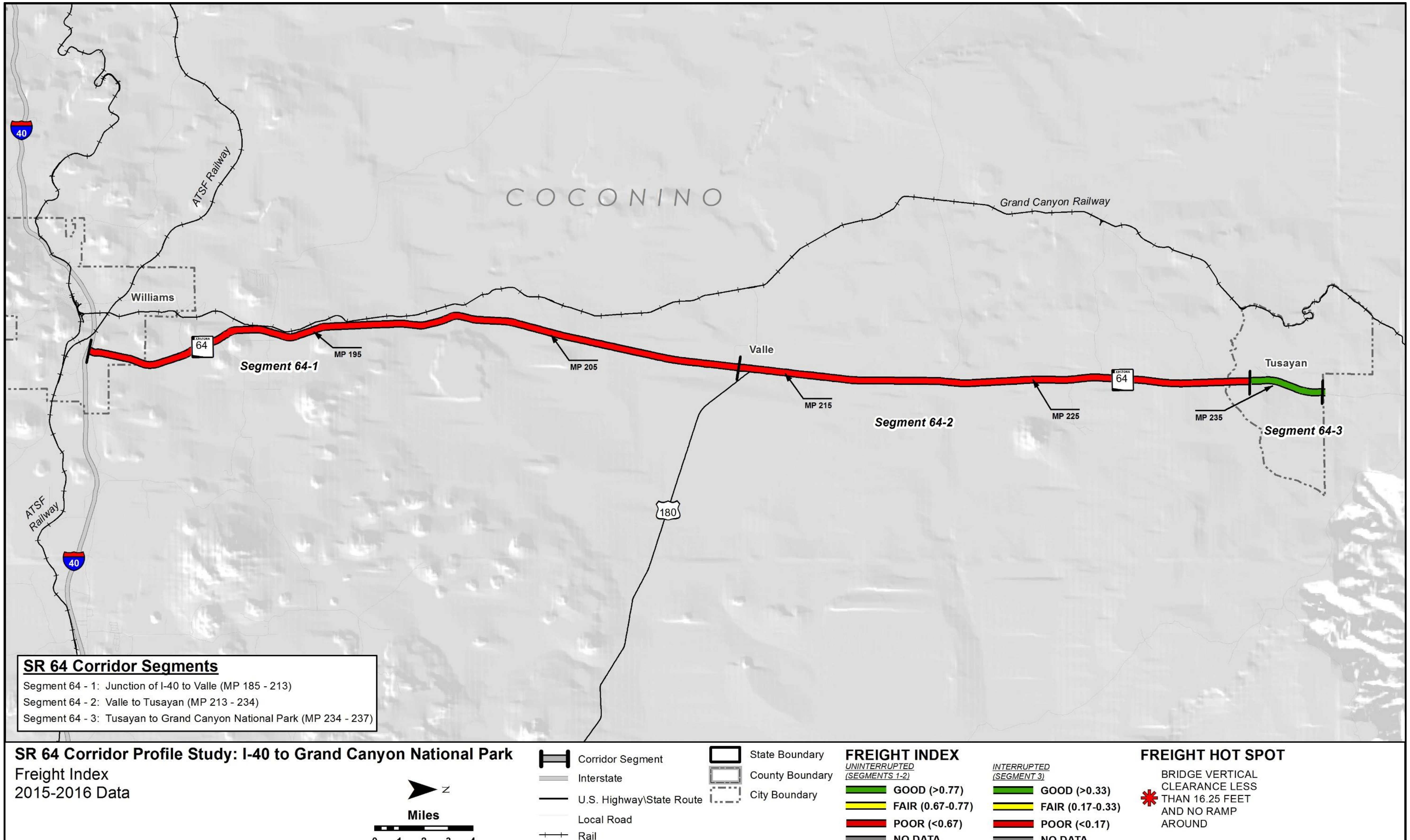
Table 9 summarizes the Freight performance results for the SR 64 corridor. **Figure 16** illustrates the primary Freight Index performance and locations of freight hot spots along the SR 64 corridor. Maps for each secondary measure can be found in **Appendix A**.

Table 9: Freight Performance

Segment #	Segment Length (miles)	Freight Index	Directional TTTI		Directional TPTI		Closure Duration (minutes/milepost/ year/mile)		Bridge Vertical Clearance (feet)
			EB	WB	EB	WB	EB	WB	
64-1[2^]	28	0.42	1.10	1.19	1.54	3.24	264.89	4.46	No UP
64-2[2^]	21	0.28	1.14	1.30	2.46	4.60	271.39	1.15	No UP
64-3[2*]	3	0.68	1.03	1.32	1.00	1.96	231.20	8.67	No UP
Weighted Corridor Average		0.38	1.11	1.24	1.88	3.72	265.57	3.37	0.00
SCALES									
Performance Level		**Uninterrupted Interrupted**					**All**		
Good	> 0.77^ > 0.33*		< 1.15^ < 1.30*		< 1.30^ < 3.00*		< 44.18		> 16.5
Fair	0.67 - 0.77^ 0.17 - 0.33*		1.15 -1.33^ 1.30 - 2.00*		1.30 - 1.50^ 3.00-6.00*		44.18 -124.86		16.0 - 16.5
Poor	< 0.67^ < 0.17*		> 1.33^ > 2.00*		> 1.50^ > 6.00*		> 124.86		< 16.0

[1]Urban Operating Environment
[2]Rural Operating Environment
^Uninterrupted Flow Facility
*Interrupted Flow Facility

Figure 16: Freight Performance



2.7 Corridor Performance Summary

Based on the results presented in the preceding sections, the following general observations were made related to the performance of the SR 64 corridor considering the weighted averages:

- Pavement Index averages to “fair” overall performance for the SR 64 corridor
- Bridge Index shows “good” overall performance for the SR 64 corridor
- Mobility Index shows “good” overall performance for the SR 64 corridor
- Safety Index shows “good” overall performance for the SR 64 corridor
- Freight Index shows “poor” overall performance for the SR 64 corridor
- The lowest performance along the SR 64 corridor occurs in the Freight performance area with the Bridge, Mobility and Safety performance areas showing the highest performance.

Figure 17 shows the percentage of the SR 64 corridor that rates either “good/above average” performance, “fair/average” performance, or “poor/below average” performance for each primary measure. On the SR 64 corridor, Freight is the lowest performing area with 94% of the corridor in “poor” condition as it relates to the primary measure. Bridge, Mobility and Safety are the highest performing areas along the SR 64 corridor with 100% of the corridor in “good” condition as it relates to the primary measures.

Table 10 shows a summary of corridor performance for all primary measures and secondary measure indicators for the SR 64 corridor. A weighted corridor average rating (based on the length of the segment) was calculated for each primary and secondary measure. The weighted average ratings are summarized in **Figure 18** which also provides a brief description of each performance measure. **Figure 18** represents the average for the entire corridor and any given segment or location could have a higher or lower rating than the corridor average.

Figure 17: Performance Summary by Primary Measure

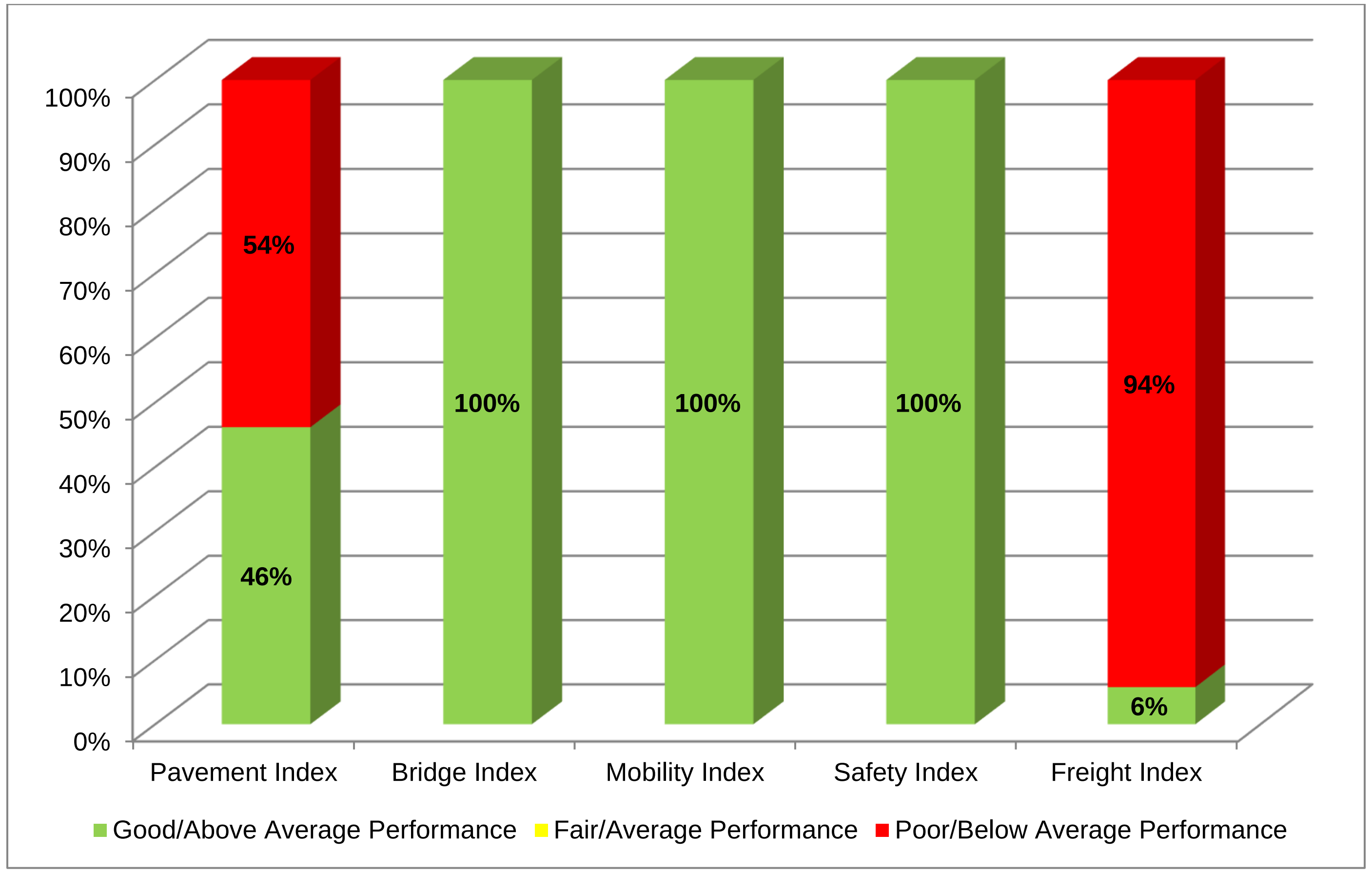
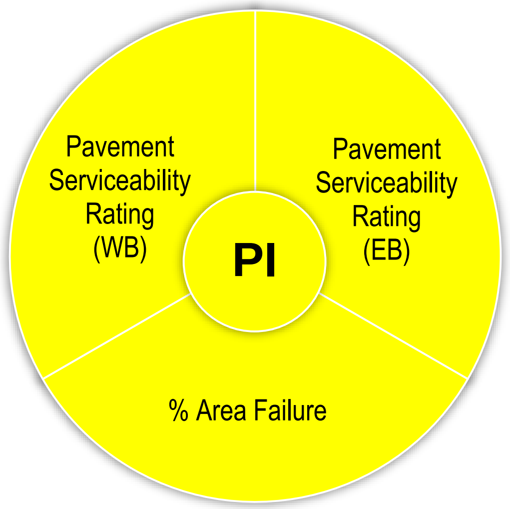
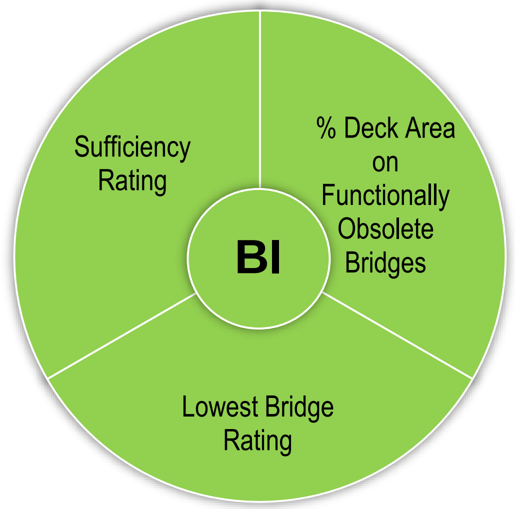
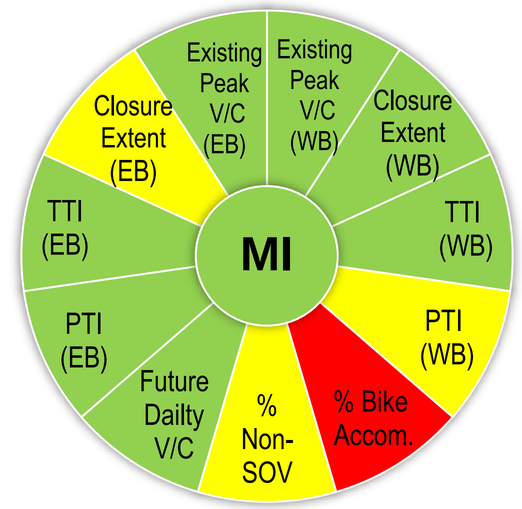
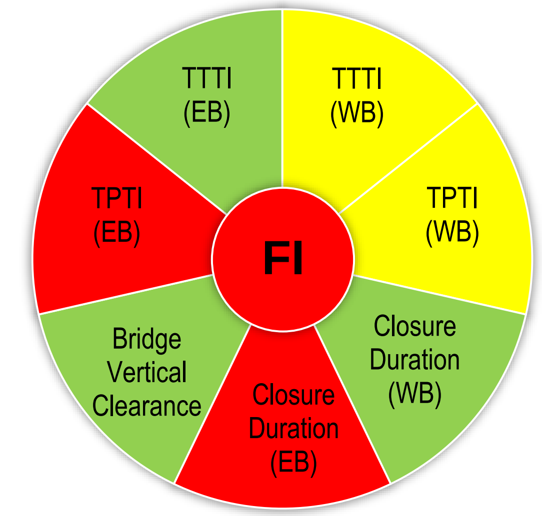


Figure 18: Corridor Performance Summary by Performance Measure









Pavement	Bridge	Mobility	Safety	Freight
Pavement Index (PI): based on two pavement condition ratings from the ADOT Pavement Database; the two ratings are the International Roughness Index (IRI) and the Cracking Rating	**Bridge Index (BI):** based on four bridge condition ratings from the ADOT Bridge Database; the four ratings are the Deck Rating, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating	**Mobility Index (MI):** an average of the existing daily volume-to-capacity (V/C) ratio and the projected 2035 daily V/C ratio	**Safety Index (SI):** combines the bi-directional frequency and rate of fatal and incapacitating injury crashes, compared to crash occurrences on similar roadways in Arizona	**Freight Index (FI):** a reliability performance measure based on the bi-directional planning time index for truck travel
➢ **Directional Pavement Serviceability Rating (PSR)** – the weighted average (based on number of lanes) of the PSR for the pavement in each direction of travel ➢ **% Area Failure** – the percentage of pavement area rated above failure thresholds for IRI or Cracking	➢ **Sufficiency Rating**– multipart rating includes structural adequacy and safety factors as well as functional aspects such as traffic volume and length of detour ➢ **% of Deck Area on Functionally Obsolete Bridges**– the percentage of deck area in a segment that is on functionally obsolete bridges; identifies bridges that no longer meet standards for current traffic volumes, lane width, shoulder width, or bridge rails; a bridge that is functionally obsolete may still be structurally sound ➢ **Lowest Bridge Rating** –the lowest rating of the four bridge condition ratings on each segment	➢ **Future Daily V/C** – the future 2035 V/C ratio provides a measure of future congestion if no capacity improvements are made to the corridor ➢ **Existing Peak Hour V/C** – the existing peak hour V/C ratio for each direction of travel provides a measure of existing peak hour congestion during typical weekdays ➢ **Closure Extent** – the average number of instances a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel ➢ **Directional Travel Time Index (TTI)** – the ratio of the average peak period travel time to the free-flow travel time; the TTI represents recurring delay along the corridor ➢ **Directional Planning Time Index (PTI)** – the ratio of the 95th percentile travel time to the free-flow travel time; the PTI represents non-recurring delay along the corridor ➢ **% Bicycle Accommodation** – the percentage of a segment that accommodates bicycle travel ➢ **% Non-single Occupancy Vehicle (Non-SOV) Trips** –the percentage of trips that are taken by vehicles carrying more than one occupant	➢ **Directional Safety Index** – the combination of the directional frequency and rate of fatal and incapacitating injury crashes, compared to crash occurrences on similar roadways in Arizona ➢ **% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors** – the percentage of fatal and incapacitating crashes that involve at least one of the five Strategic Highway Safety Plan (SHSP) emphasis areas on a given segment compared to the statewide average percentage on roads with similar operating environments ➢ **% of Fatal + Incapacitating Crashes Involving SHSP Crash Unit Types** – the percentage of total fatal and incapacitating injury crashes that involves a given crash unit type (motorcycle, truck, non-motorized traveler) compared to the statewide average percentage on roads with similar operating environments	➢ **Directional Truck Travel Time Index (TTTI)** – the ratio of the average peak period truck travel time to the free-flow truck travel time; the TTTI represents recurring delay along the corridor ➢ **Directional Truck Planning Time Index (TPTI)** – the ratio the 95th percentile truck travel time to the free-flow truck travel time; the TPTI represents non-recurring delay along the corridor ➢ **Closure Duration** – the average time a particular milepost is closed per year per mile on a given segment of the corridor in a specific direction of travel ➢ **Bridge Vertical Clearance** – the minimum vertical clearance over the travel lanes for underpass structures on each segment.

Table 10: Corridor Performance Summary by Segment and Performance Measure

Segment #	Segment Length (miles)	Pavement Performance Area				Bridge Performance Area				Mobility Performance Area											
		Pavement Index	Directional PSR		% Area Failure	Bridge Index	Sufficiency Rating	% of Deck Area on Functionally Obsolete Bridges	Lowest Bridge Rating	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent (instances/ milepost/year/mile)		Directional TTI (all vehicles)		Directional PTI (all vehicles)		% Bicycle Accommodation	% Non-Single Occupancy Vehicle (SOV) Trips
			EB	WB								EB	WB	EB	WB	EB	WB	EB	WB		
64-1^[c2]	28	2.88	3.09		38.0%	7.00	85.00	0.0%	7	0.22	0.22	0.21	0.21	0.33	0.03	1.01	1.06	1.27	1.59	5%	13.9%
64-2^[c2]	21	3.60	3.50		0.0%	No Bridges				0.28	0.32	0.28	0.26	0.28	0.01	1.02	1.17	2.03	2.57	4%	16.8%
64-3*[b2]	3	3.69	3.52		0.0%	No Bridges				0.55	0.65	0.35	0.35	0.20	0.07	1.07	1.16	1.00	2.04	95%	10.6%
Weighted Corridor Average		3.22	3.28		20%	7.00	84.60	0%	7.00	0.26	0.29	0.25	0.24	0.30	0.02	1.02	1.11	1.56	2.01	9%	15%
SCALES																					
Performance Level		**Non-Interstate**				**All**				**Urban and Fringe Urban**				**All**		**Uninterrupted**				**All**	
Good/Above Average		> 3.50			< 5%	> 6.5	> 80	< 12%	> 6	< 0.71				< 0.22		< 1.15		< 1.3		> 90%	> 17%
Fair/Average		2.90 - 3.50			5% - 20%	5.0 - 6.5	50 - 80	12% - 40%	5 - 6	0.71 - 0.89				0.22 - 0.62		1.15 - 1.33		1.3 - 1.5		60% - 90%	11% - 17%
Poor/Below Average		< 2.90			> 20%	< 5.0	< 50	> 40%	< 5	> 0.89				> .62		> 1.33		> 1.5		< 60%	< 11%
Performance Level										**Rural**						**Interrupted**					
Good/Above Average										< 0.56						< 1.3		< 3.0			
Fair/Average										0.56 - 0.76						1.3 – 2.0		3.0 – 6.0			
Poor/Below Average										> 0.76						> 2.0		> 6.0			

^Uninterrupted Flow Facility
*Interrupted Flow Facility
[a]2 or 3 or 4 Lane Divided Highway
[b]4 or 5 Lane Undivided Highway
[c]2 or 3 Lane Undivided Highway
[1]Urban Operating Environment
[2]Rural Operating Environment

Table 10: Corridor Performance Summary by Segment and Performance Measure (continued)

Segment #	Segment Length (miles)	Safety Performance Area							Freight Performance Area							
		Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Freight Index	Directional TTTI		Directional TPTI		Closure Duration (minutes/milepost/year/mile)		Bridge Vertical Clearance (feet)
			EB	WB						EB	WB	EB	WB	EB	WB	
64-1[^c2]	28	0.27	0.45	0.09	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	0.42	1.10	1.19	1.54	3.24	264.89	4.46	No UP
64-2[^c2]	21	0.36	0.08	0.64	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	0.28	1.14	1.30	2.46	4.60	271.39	1.15	No UP
64-3[*b2]	3	0.08	0.00	0.16	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	0.68	1.03	1.32	1.00	1.96	231.20	8.67	No UP
Weighted Corridor Average		0.30	0.27	0.32	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	0.38	1.11	1.24	1.88	3.72	265.57	3.37	0.00

SCALES

Performance Level	2 or 3 or 4 Lane Divided Highway					Uninterrupted			All	
Good/Above Average	< 0.77	< 44%	< 4%	< 16%	< 2%	> 0.77	< 1.15	< 1.3	< 44.18	> 16.5
Fair/Average	0.77 - 1.23	44% - 54%	4% - 7%	16% - 26%	2% - 4%	0.67 - 0.77	1.15 - 1.33	1.3 - 1.5	44.18-124.86	16.0 - 16.5
Poor/Below Average	> 1.23	> 54%	> 7%	> 26%	> 4%	< 0.67	> 1.33	> 1.5	> 124.86	< 16.0
Performance Level	**2 or 3 Lane Undivided Highway**					**Interrupted**				
Good/Above Average	< 0.94	< 51%	< 6%	< 19%	< 5%	> 0.33	< 1.3	< 3.0		
Fair/Average	0.94 - 1.06	51% - 58%	6% - 10%	19% - 27%	5% - 8%	0.17 - 0.33	1.3 - 2.0	3.0 - 6.0		
Poor/Below Average	> 1.06	> 58%	> 10%	> 27%	> 8%	< 0.17	> 2.0	> 6.0		
Performance Level	**4 or 5 Undivided Highway**									
Good/Above Average	< 0.80	< 42%	< 6%	< 6%	< 5%					
Fair/Average	0.80 - 1.20	42% - 51%	6% - 10%	6% - 9%	5% - 8%					
Poor/Below Average	> 1.20	> 51%	> 10%	> 9%	> 8%					

^Uninterrupted Flow Facility
*Interrupted Flow Facility
[a]2 or 3 or 4 Lane Divided Highway
[b]4 or 5 Lane Undivided Highway
[c]2 or 3 Lane Undivided Highway
[1]Urban Operating Environment
[2]Rural Operating Environment

Notes: *"Insufficient Data" indicates there was not enough data available to generate reliable performance ratings*
"No UP" indicates no underpasses are present in the segment

3.0 NEEDS ASSESSMENT

3.1 Corridor Objectives

Statewide goals and performance measures were established by the ADOT Long-Range Transportation Plan (LRTP), 2010-2035. Statewide performance goals that are relevant to SR 64 performance areas were identified and corridor goals were then formulated for each of the five performance areas that aligned with the overall statewide goals established by the LRTP. Based on stakeholder input, corridor goals, corridor objectives, and performance results, three "emphasis areas" were identified for the SR 64 corridor: Pavement, Mobility, and Safety.

Considering the corridor goals and identified emphasis areas, performance objectives were developed for each quantifiable performance measure that identify the desired level of performance based on the performance scale levels for the overall corridor and for each segment of the corridor. For the performance emphasis areas, the corridor-wide weighted average performance objectives are identified with a higher standard than for the other performance areas. **Table 11** shows the SR 64 corridor goals, corridor objectives, and performance objectives, and how they align with the statewide goals.

It is not reasonable within a financially constrained environment to expect that every performance measure will always be at the highest levels on every corridor segment. Therefore, individual corridor segment objectives have been set as "fair/average" or better and should not fall below that standard.

Achieving corridor and segment performance objectives will help ensure that investments are targeted toward improvements that support the safe and efficient movement of travelers on the corridor. Addressing current and future congestion, thereby improving mobility on congested segments, will also help the corridor fulfill its potential as a significant contributor to the region's economy.

Corridor performance is measured against corridor and segment objectives to determine needs – the gap between observed performance and performance objectives.

Goal achievement will improve or reduce current and future congestion, increase travel time reliability, and reduce fatalities and incapacitating injuries resulting from vehicle crashes. Where performance is currently rated "good", the goal is always to maintain that standard, regardless of whether or not the performance is in an emphasis area.

Table 11: Corridor Performance Goals and Objectives

ADOT Statewide LRTP Goals	SR 64 Corridor Goals	SR 64 Corridor Objectives	Performance Area	Primary Measure / Secondary Measure Indicators	Performance Objective: Corridor Average	Performance Objective: Segment
Improve Mobility, Reliability, and Accessibility **Make Cost Effective Investment Decisions and Support Economic Vitality**	Provide a safe and reliable route for recreational and tourist travel Provide safe, reliable and efficient connection to all communities along the corridor to permit efficient regional travel	Reduce current and future congestion and delay in the urbanized areas Improve access management and provide guidance for future connections within the corridor Reduce delays from non-recurring events and incidents to improve reliability Improve bicycle and pedestrian accommodations Utilize technology to optimize existing system capacity and performance	Mobility (*Emphasis Area*)	Mobility Index	Good	Fair or better
				Future Daily V/C		
				Existing Peak Hour V/C		
				Closure Extent		
				Directional Travel Time Index		
				Directional Planning Time Index		
				% Bicycle Accommodation		
				% Non-SOV Trips		
	Provide a safe, reliable and efficient freight route	Reduce delays and restrictions to freight movement to improve reliability Improve travel time reliability (including impacts to motorists due to freight traffic)	Freight	Freight Index	Fair or better	Fair or better
				Directional Truck Travel Time Index		
				Directional Truck Planning Time Index		
				Closure Duration		
				Bridge Vertical Clearance		
Preserve and Maintain the System	Preserve and modernize highway infrastructure	Maintain structural integrity of bridges	Bridge	Bridge Index	Fair or better	Fair or better
				Sufficiency Rating		
				% of Deck Area on Functionally Obsolete Bridges		
				Lowest Bridge Rating		
		Improve pavement ride quality for all corridor users	Pavement (*Emphasis Area*)	Pavement Index	Good	Fair or better
				Directional Pavement Serviceability Rating		
				% Area Failure		
Enhance Safety	Provide a safe, reliable, and efficient connection for the communities along the corridor Promote safety by implementing appropriate countermeasures	Reduce fatal and incapacitating injury crashes Reduce wildlife-related crashes	Safety (*Emphasis Area*)	Safety Index	Above Average	Average or better
				Directional Safety Index		
				% of Crashes Involving SHSP Top 5 Emphasis Areas Behaviors		
				% of Crashes Involving Crash Unit Types		

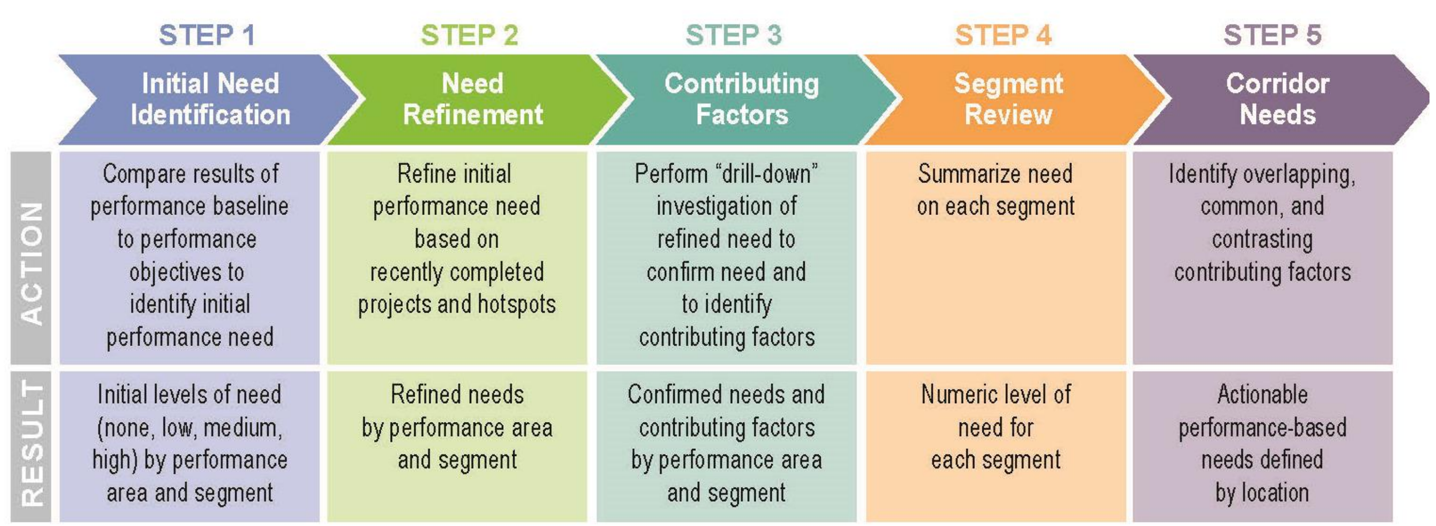
3.2 Needs Assessment Process

The following guiding principles were used as an initial step in developing a framework for the performance-based needs assessment process:

- Corridor needs are defined as the difference between the corridor performance and the performance objectives
- The needs assessment process should be systematic, progressive, and repeatable, but also allow for engineering judgment where needed
- The process should consider all primary and secondary performance measures developed for the study
- The process should develop multiple need levels including programmatic needs for the entire length of the corridor, performance area-specific needs, segment-specific needs, and location-specific needs (defined by MP limits)
- The process should produce actionable needs that can be addressed through strategic investments in corridor preservation, modernization, and expansion

The performance-based needs assessment process is illustrated in **Figure 19** and described in the following sections.

Figure 19: Needs Assessment Process



Step 1: Initial Needs Identification

The first step in the needs assessment process links baseline (existing) corridor performance with performance objectives. In this step, the baseline corridor performance is compared to the performance objectives to provide a starting point for the identification of performance needs. This mathematical comparison results in an initial need rating of None, Low, Medium, or High for each primary and secondary performance measure. An illustrative example of this process is shown below in **Figure 20**.

Figure 20: Initial Need Ratings in Relation to Baseline Performance (Bridge Example)

Performance Thresholds	Performance Level	Initial Level of Need	Description
	Good	None*	All levels of Good and top 1/3 of Fair (>6.0)
	Good		
	Good		
6.5	Fair		
	Fair	Low	Middle 1/3 of Fair (5.5-6.0)
	Fair	Medium	Lower 1/3 of Fair and top 1/3 of Poor (4.5-5.5)
5.0	Poor		
	Poor	High	Lower 2/3 of Poor (<4.5)
	Poor		

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

The initial level of need for each segment is refined to account for hot spots and recently completed or under construction projects, resulting in a final level of need for each segment. The final levels of need for each primary and secondary performance measure are combined to produce a weighted final need rating for each segment. Values of 0, 1, 2, and 3 are assigned to the initial need levels of None, Low, Medium, and High, respectively. A weight of 1.0 is applied to the Performance Index need and equal weights of 0.20 are applied to each need for each secondary performance measure. For directional secondary performance measures, each direction of travel receives a weight of 0.10.

Step 2: Need Refinement

In Step 2, the initial level of need for each segment is refined using the following information and engineering judgment:

- For segments with an initial need of None that contain hot spots, the level of need should be increased from None to Low
- For segments with an initial level of need where recently completed projects or projects under construction are anticipated to partially or fully address the identified need, the level of need should be reduced or eliminated as appropriate
- Programmed projects that are expected to partially or fully address an identified need are not justification to lower the initial need because the programmed projects may not be implemented as planned; in addition, further investigations may suggest that changes in the scope of a programmed project may be warranted

The resulting final needs are carried forward for further evaluation in Step 3.

Step 3: Contributing Factors

In Step 3, a more detailed review of the condition and performance data available from ADOT is conducted to identify contributing factors to the need. Typically, the same databases used to develop the baseline performance serve as the principal sources for the more detailed analysis.

However, other supplemental databases may also be useful sources of information. The databases used for diagnostic analysis are listed below:

Pavement Performance Area

- Pavement Rating Database

Bridge Performance Area

- ABISS

Mobility Performance Area

- Highway Performance Monitoring System (HPMS) Database
- AZTDM
- Real-time traffic conditions data produced by American Digital Cartography Inc. (HERE) Database
- Highway Conditions Reporting System (HCRS) Database

Safety Performance Area

- Crash Database

Freight Performance Area

- HERE Database
- HCRS Database

In addition, other sources considered helpful in identifying contributing factors are:

- Maintenance history (from ADOT PeCoS database for pavement), the level of past investments, or trends in historical data that provide context for pavement and bridge history
- Field observations from ADOT district personnel can be used to provide additional information regarding a need that has been identified
- Previous studies can provide additional information regarding a need that has been identified

Step 3 results in the identification of performance-based needs and contributing factors by segment (and MP locations, if appropriate) that can be addressed through investments in preservation, modernization, and expansion projects to improve corridor performance. See **Appendix D** for more information.

Step 4: Segment Review

In this step, the needs identified in Step 2 and refined in Step 3 are quantified for each segment to numerically estimate the level of need for each segment. Values of 0 to 3 are assigned to the final need levels (from Step 3) of None, Low, Medium, and High, respectively. A weighting factor is applied to the performance areas identified as emphasis areas and a weighted average need is calculated for each segment. The resulting average need score can be used to compare levels of need between segments within a corridor and between segments in different corridors.

Step 5: Corridor Needs

In this step, the needs and contributing factors for each performance area are reviewed on a segment-by-segment basis to identify actionable needs and to facilitate the formation of solution sets that address multiple performance areas and contributing factors. The intent of this process is to identify overlapping, common, and contrasting needs to help develop strategic solutions. This step results in the identification of corridor needs by specific location.

3.3 Corridor Needs Assessment

This section documents the results of the needs assessment process described in the prior section. The needs in each performance area were classified as either None, Low, Medium, or High based on how well each segment performed in the existing performance analysis. The needs for each segment were numerically combined to estimate the average level of need for each segment of the corridor

The final needs assessments for each performance measure, along with the scales used in analysis, are shown in **Table 12** through **Table 16**.

Pavement Needs Refinement and Contributing Factors

- Recently completed projects in the corridor did not result in an adjustment to level of need
- See **Appendix D** for detailed information on contributing factors

Table 12: Final Pavement Needs

Segment #	Performance Score and Level of Need				Initial Segment Need	Hot Spots	Recently Completed Projects	Final Segment Need
	Pavement Index	Directional PSR		% Area Failure				
		EB	WB					
64-1	2.88	3.09	3.09	38%	3.00	MP 188-189 MP 198-200 MP 205-212	None	High
64-2	3.60	3.50	3.50	0%	0.00	None	None	None
64-3	3.69	3.52	3.52	0%	0.00	None	None	None

Level of Need (Score)	Performance Score Need Scale		Segment Level Need Scale
None* (0)	> 3.30	< 10%	0
Low (1)	3.10 - 3.30	10% - 15%	< 1.5
Medium (2)	2.70 - 3.10	15% - 25%	1.5 - 2.5
High (3)	< 2.70	> 25%	> 2.5

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Bridge Needs Refinement and Contributing Factors

- The only bridge within the corridor does not exhibit potential historical investment issues
- No recently completed bridge projects have occurred on the corridor
- See **Appendix D** for detailed information on contributing factors

Table 13: Final Bridge Needs

Segment #	Performance Score and Level of Need				Initial Segment Need	Hot Spots	Recently Completed Projects	Final Segment Need
	Bridge Index	Sufficiency Rating	% of Deck on Functionally Obsolete Bridges	Lowest Bridge Rating				
64-1	7.00	84.60	0.00%	7.00	0.0	None	None	None
64-2	No Bridges				None	None	None	None
64-3	No Bridges				None	None	None	None

Level of Need (Score)	Performance Score Need Scale				Segment Level Need Scale
None (0)	> 6.0	> 70	> 5.0	< 21.0%	0
Low (1)	5.5 - 6.0	60 - 70	5.0	21.0% - 31.0%	< 1.5
Medium (2)	4.5 - 5.5	40 - 60	4.0	31.0% - 49.0%	1.5 - 2.5
High (3)	< 4.5	< 40	< 4.0	> 49.0%	> 2.5

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Mobility Needs Refinement and Contributing Factors

- The Low level of need was adjust to None due to recently completed mobility projects within Segment 64-3
- See **Appendix D** for detailed information on contributing factors

Table 14: Final Mobility Needs

Segment	Performance Score and Level of Need											Initial Segment Need	Recently Completed Projects	Final Segment Need
	Mobility Index	Future Daily V/C	Existing Peak Hour V/C		Closure Extent		Directional TTI		Directional PTI		% Bicycle Accommodation			
			EB	WB	EB	WB	EB	WB	EB	WB				
64-1	0.22	0.22	0.21	0.21	0.33	0.03	1.01	1.06	1.27	1.59	5%	0.9	None	Low
64-2	0.28	0.32	0.28	0.26	0.28	0.01	1.02	1.17	2.03	2.57	4%	1.2	None	Low
64-3	0.55	0.65	0.35	0.35	0.20	0.07	1.07	1.16	1.00	2.04	95%	0.2	FY16 H7832: TUSAYAN STREETS PH-II, New Sidewalks, Landscape (MP 235.15-236.10) FY16 H8258: Grand Canyon Airport/FS Road 328, Construct Shoulder Widening (MP 234.24-237.05)	None

Level of Need (Score)	Performance Score Need Scale					Segment Level Need Scale
None* (0)	≤ 0.77 (Urban) ≤ 0.63 (Rural)	< 0.35	< 1.21[a] < 1.53[b]	< 1.37[a] < 4.00[b]	> 80%	0
Low (1)	0.77 - 0.83 (Urban) 0.63 - 0.69 (Rural)	0.35 - 0.49	1.21 - 1.27[a] 1.53 - 1.77[b]	1.37 - 1.43[a] 4.00 - 5.00[b]	70% - 80%	< 1.5
Medium (2)	0.83 - 0.95 (Urban) 0.69 - 0.83 (Rural)	0.49 - 0.75	1.27 - 1.39[a] 1.77 - 2.23[b]	1.43 - 1.57[a] 5.00 - 7.00[b]	50% - 70%	1.5 - 2.5
High (3)	≥ 0.95 (Urban) ≥ 0.83 (Rural)	> 0.75	> 1.39[a] > 2.23[b]	> 1.57[a] > 7.00[b]	< 50%	> 2.5

a: Uninterrupted
b: Interrupted

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Safety Needs Refinements and Contributing Factors

- No adjustments were made between the initial and final needs of safety
- See **Appendix D** for detailed information on contributing factors

Table 15: Final Safety Needs

Segment	Performance Score and Level of Need							Initial Segment Need	Hot Spots	Recently Completed Projects	Final Segment Need
	Safety Index	Directional Safety Index		% of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Area Behaviors	% of Fatal + Incapacitating Injury Crashes Involving Trucks	% of Fatal + Incapacitating Injury Crashes Involving Motorcycles	% of Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers				
		EB	WB								
64-1	0.27	0.45	0.09	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	0.0	-	None	None
64-2	0.36	0.08	0.64	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	0.0	-	None	None
64-3	0.08	0.00	0.16	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	*Insufficient Data*	0.0	-	FY16 H7832: TUSAYAN STREETS PH-II, New Sidewalks, Landscape (MP 235.15-236.10) FY16 H8258: Grand Canyon Airport/FS Road 328, Construct Shoulder Widening (MP 234.24-237.05)	None

Level of Need (Score)		Performance Score Needs Scale					Segment Level Need Scale
None* (0)	a	≤ 0.92	≤ 47%	≤ 5%	≤ 19%	≤ 3%	0
	b	≤ 0.93	≤ 45%	≤ 7%	≤ 7%	≤ 6%	
	c	≤ 0.98	≤ 53%	≤ 6%	≤ 22%	≤ 3%	
Low (1)	a	0.92 - 1.07	47% - 50%	5% - 6%	19% - 22%	3% - 4%	≤ 1.5
	b	0.93 - 1.06	45% - 48%	7% - 8%	7% - 8%	6% - 7%	
	c	0.98 - 1.02	53% - 55%	6% - 7%	22% - 25%	3% - 4%	
Medium (2)	a	1.07 - 1.38	50% - 57%	6% - 8%	22% - 29%	4% - 5%	1.5 - 2.5
	b	1.06 - 1.33	48% - 54%	8% - 11%	8% - 10%	7% - 9%	
	c	1.02 - 1.10	55% - 59%	7% - 8%	25% - 30%	4% - 5%	
High (3)	a	≥ 1.38	≥ 57%	≥ 8%	≥ 29%	≥ 5%	≥ 2.5
	b	≥ 1.33	≥ 54%	≥ 11%	≥ 10%	≥ 9%	
	c	≥ 1.10	≥ 59%	≥ 8%	≥ 30%	≥ 5%	

a: 2 or 3 or 4 Lane Divided Highway
b: 4 or 5 Lane Undivided Highway
c: 2 or 3 Lane Undivided Highway

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

<u>*Freight Needs Refinements and Contributing Factors*</u>

- No recently completed projects have resulted in an adjusted freight need
- See **Appendix D** for detailed information on contributing factors

Table 16: Final Freight Needs

Segment	Performance Score and Level of Need								Initial Segment Need	Hot Spots	Recently Completed Projects	Final Segment Need
	Freight Index	Directional TTTI		Directional TPTI		Closure Duration		Bridge Vertical Clearance				
		EB	WB	EB	WB	EB	WB					
64-1	0.42	1.10	1.19	1.54	3.24	264.89	4.46	No UP	3.8	0	None	High
64-2	0.28	1.14	1.30	2.46	4.60	271.39	1.15	No UP	4.1	0	None	High
64-3	0.68	1.03	1.32	1.00	1.96	231.20	8.67	No UP	0.3	0	FY16 H7832: TUSAYAN STREETS PH-II, New Sidewalks, Landscape (MP 235.15-236.10) FY16 H8258: Grand Canyon Airport/FS Road 328, Construct Shoulder Widening (MP 234.24-237.05)	Low

Level of Need (Score)		Performance Score Need Scale					Segment Level Need Scale
None* (0)	a b	≥ 0.74 ≥ 0.28	≤ 1.21 ≤ 1.53	≤ 1.37 ≤ 4.00	≤ 71.07	≥ 16.33	0
Low (1)	a b	0.70 - 0.74 0.22 – 0.28	1.21 - 1.27 1.53 - 1.77	1.37 - 1.43 4.00 - 5.00	71.07 - 97.97	16.17 - 16.33	≤ 1.5
Medium (2)	a b	0.64 - 0.70 0.12 – 0.22	1.27 - 1.39 1.77 - 2.23	1.43 - 1.57 5.00 - 7.00	97.97 - 151.75	15.83 - 16.17	1.5 - 2.5
High (3)	a b	≤ 0.64 ≤ 0.12	≥ 1.39 ≥ 2.23	≥ 1.57 ≥ 7.00	≥ 151.75	≤ 15.83	≥ 2.5

a: Uninterrupted Flow
b: Interrupted Flow

**A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

Segment Review

The needs for each segment were combined to numerically estimate the average level of need for each segment of the corridor. **Table 17** provides a summary of needs for each segment across all performance areas, with the average need score for each segment presented in the last row of the table. A weighting factor of 1.5 is applied to the need scores of the performance areas identified as emphasis areas (Pavement, Mobility, and Safety for the SR 64 corridor). There is one segment with a Medium average need and two segments with a Low average need.

Table 17: Summary of Needs by Segment

Performance Area	Segment Number and Mileposts (MP)		
	64-1	64-2	64-3
	MP 185-213	MP 213-234	MP 234-237
Pavement+	High	None*	None*
Bridge	None*	None*	None*
Mobility+	Low	Low	None*
Safety+	None*	None*	None*
Freight	High	High	Low
Average Need	**1.38**	**0.69**	**0.15**

** A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

+ Identified as an emphasis area for the SR 64 corridor.

Average Need Scale	
None*	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0

Summary of Corridor

The needs in each performance area are shown in **Figure 21** and summarized below:

Pavement Needs

- Segment 64-1 contains several Pavement hot spots
- Segments 64-2 and 64-3 have final needs of None and Segment 64-1 has a High need

Bridge Needs

- Segment 64-1 includes one bridge
- Segments 64-2 and 64-3 do not include any bridges
- There are no final Bridge needs along the corridor

Mobility Needs

- Low Mobility needs exist on Segments 64-1 and 64-2
- Segment 64-2 contains High directional PTI needs in both directions
- Bicycle accommodation needs are High on Segments 64-1 and 64-2 due shoulder width less than 6' for higher speeds

Safety Needs

- There are no final Safety needs along the corridor
- There is insufficient data related to the Safety top 5 emphasis behavior areas

Freight Needs

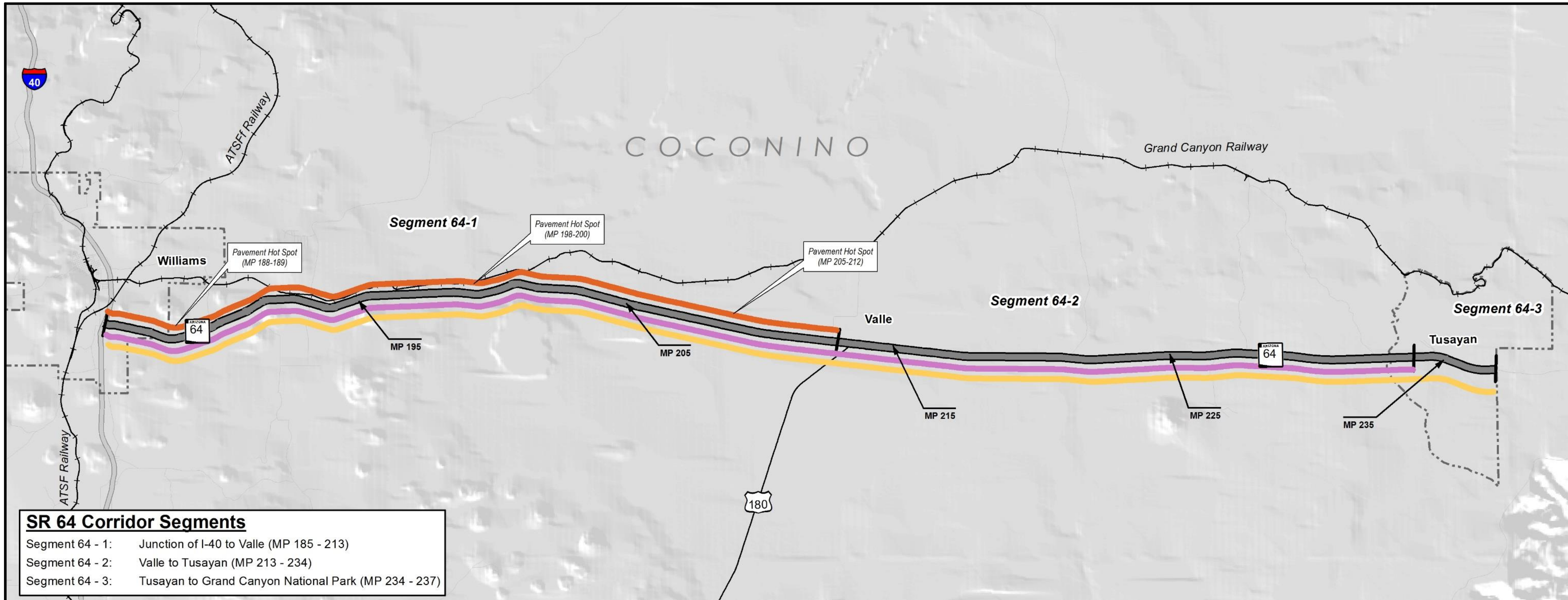
- High Freight needs exist on Segments 64-1 and 64-2
- Many segments along the corridor contain High directional PTI and closure duration needs
- No freight hot spots exist along the corridor

Overlapping Needs

This section identifies overlapping performance needs on the SR 64 corridor, which provides guidance to develop strategic solutions that address more than one performance area with elevated levels of need. Completing projects that address multiple needs presents the opportunity to more effectively improve overall performance. A summary of the overlapping needs that relate to locations with elevated levels of need is provided below:

- Segment 64-1 has the highest average need score of all the segments of the corridor with elevated Needs in the Pavement and Freight performance areas
- Segment 64-2 contains needs in the Mobility and Freight performance areas

Figure 21 Corridor Needs Summary



SR 64 Corridor Segments

Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)

Performance Area	64-1 MP 185-213	64-2 MP 213-234	64-3 MP 234-237	Performance Area
Pavement+	High	None*	None*	Pavement+
Bridge	None*	None*	None*	Bridge
Mobility+	Low	Low	None*	Mobility
Safety+	None*	None*	None*	Safety+
Freight	High	High	Low	Freight+
Average Need	1.38	0.92	0.23	Average Need

+ Identified as emphasis area for SR 64 Corridor

A segment need rating of 'None**' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study.*

N
Miles
0 1 2 3 4

Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail

State Boundary
County Boundary
City Boundary

Performance Area Needs
Safety
Pavement
Freight
Mobility
Bridge

Level of Need
None*
Low
Medium
High

SR 64 Corridor Profile Study: Williams to Grand Canyon National Park
Corridor Needs Summary

Appendix A: Corridor Performance Maps

This appendix contains maps of each primary and secondary measure associated with the five performance areas for the SR 64 corridor. The following are the areas and maps included:

Pavement Performance Area:

- Pavement Index and Hot Spots
- Pavement Serviceability (directional)
- Percentage of Pavement Area Failure

Bridge Performance Area:

- Bridge Index and Hot Spots
- Bridge Sufficiency
- Percent of Deck Area on Functionally Obsolete Bridges
- Lowest Bridge Rating

Mobility Performance Area:

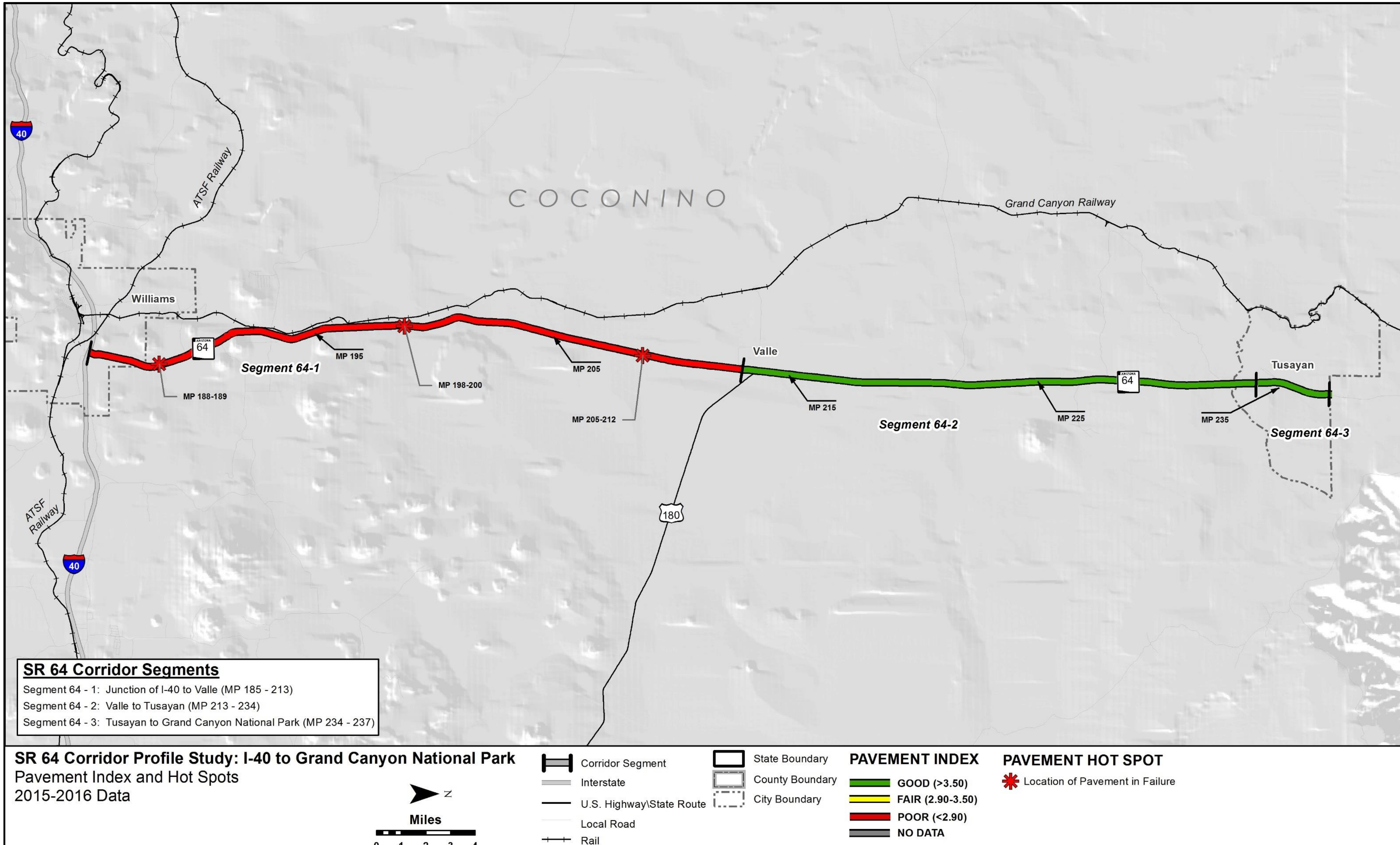
- Mobility Index
- Future Daily V/C
- Existing Peak V/C (directional)
- Average Instances Per Year a Given Milepost is Closed Per Segment Mile
- All Vehicles Travel Time Index
- All Vehicles Planning Time Index
- Multimodal Opportunities
- Percentage of Bicycle Accommodation

Safety Performance Area:

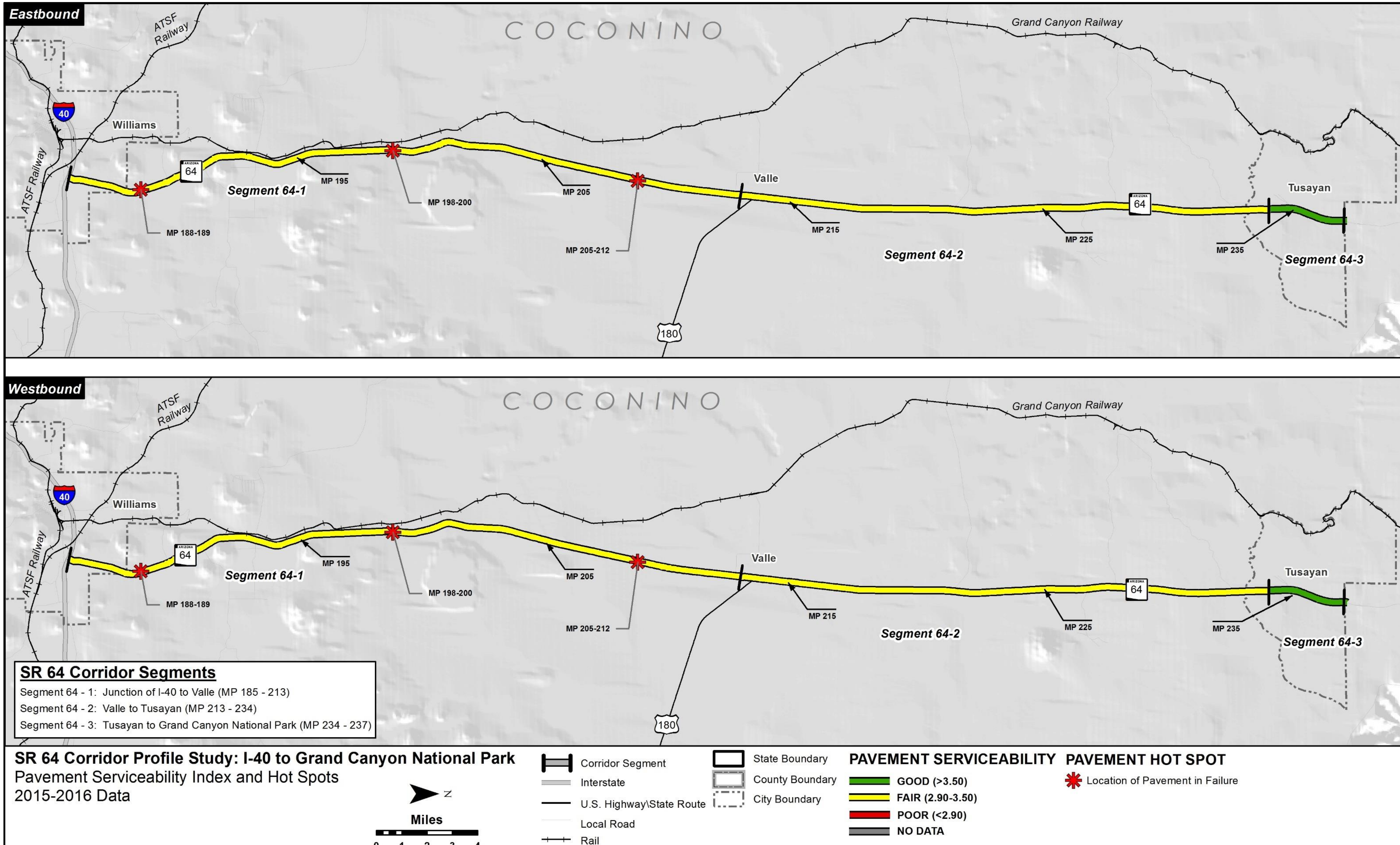
- Safety Index and Hot Spots
- Safety Index and Hot Spots (directional)
- Relative Frequency of Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors Compared to the Statewide Average for Similar Segments
- Relative Frequency of Fatal + Incapacitating Injury Crashes Involving Motorcycles Compared to the Statewide Average for Similar Segments

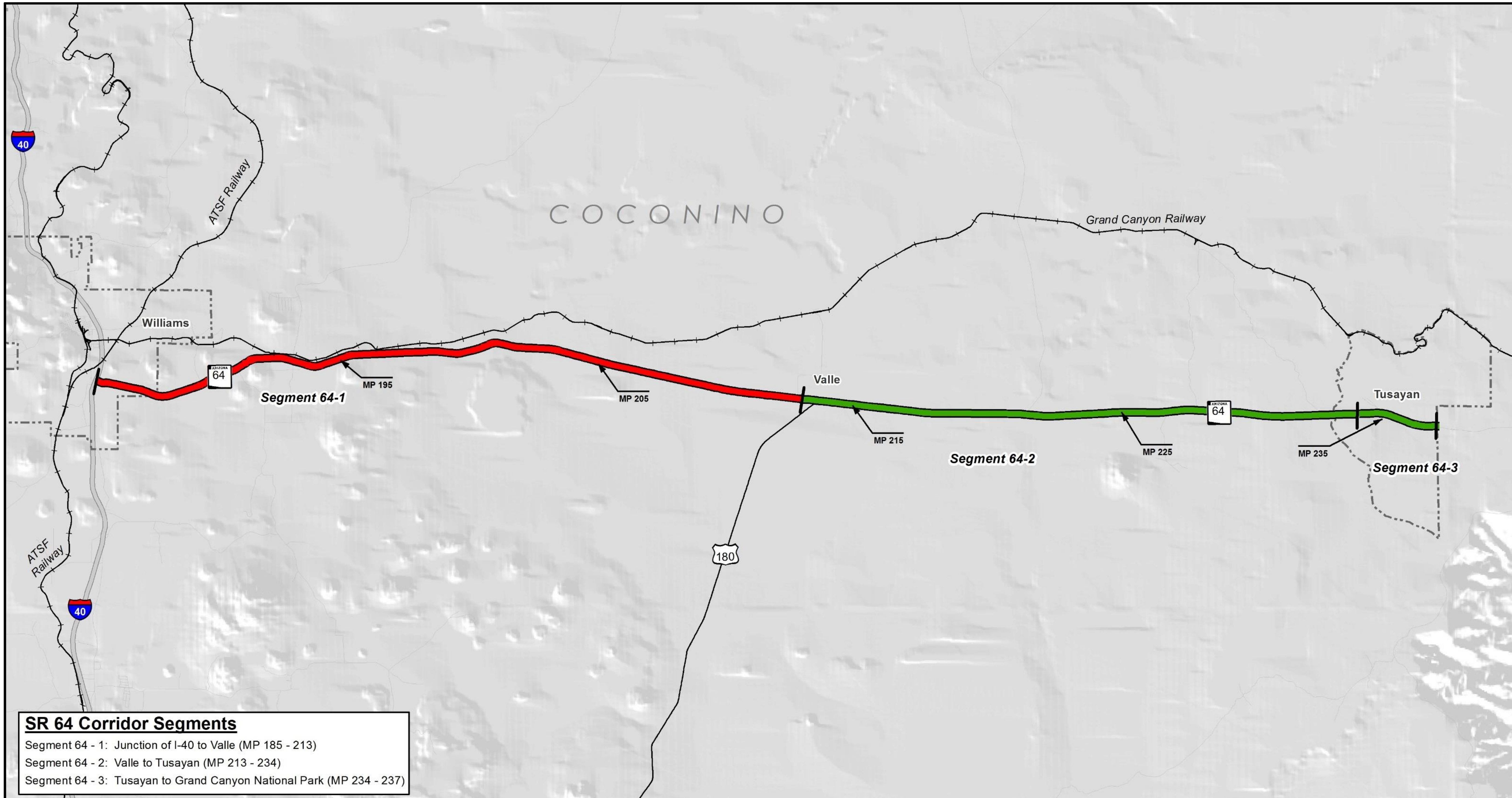
Freight Performance Area:

- Freight Index and Hot Spots
- Truck Travel Time Index
- Truck Planning Time Index
- Average Minutes Per Year Given Milepost is Closed Per Segment Mile
- Bridge Vertical Clearance



COCONINO
Grand Canyon Railway
ATSF Railway
ATSF Railway
Williams
Valle
Tusayan
40
40
64
64
180
Segment 64-1
Segment 64-2
Segment 64-3
MP 188-189
MP 195
MP 198-200
MP 205
MP 205-212
MP 215
MP 225
MP 235
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Pavement Index and Hot Spots
2015-2016 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
PAVEMENT INDEX
GOOD (>3.50)
FAIR (2.90-3.50)
POOR (<2.90)
NO DATA
PAVEMENT HOT SPOT
Location of Pavement in Failure


Eastbound
Westbound
COCONINO
ATSF Railway
Grand Canyon Railway
Williams
Valle
Tusayan
40
64
180
MP 188-189
MP 195
MP 198-200
MP 205
MP 205-212
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Pavement Serviceability Index and Hot Spots
2015-2016 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
PAVEMENT SERVICEABILITY
GOOD (>3.50)
FAIR (2.90-3.50)
POOR (<2.90)
NO DATA
PAVEMENT HOT SPOT
Location of Pavement in Failure



SR 64 Corridor Segments

Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)

SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Percentage of Pavement Area Failure
2015-2016 Data

N

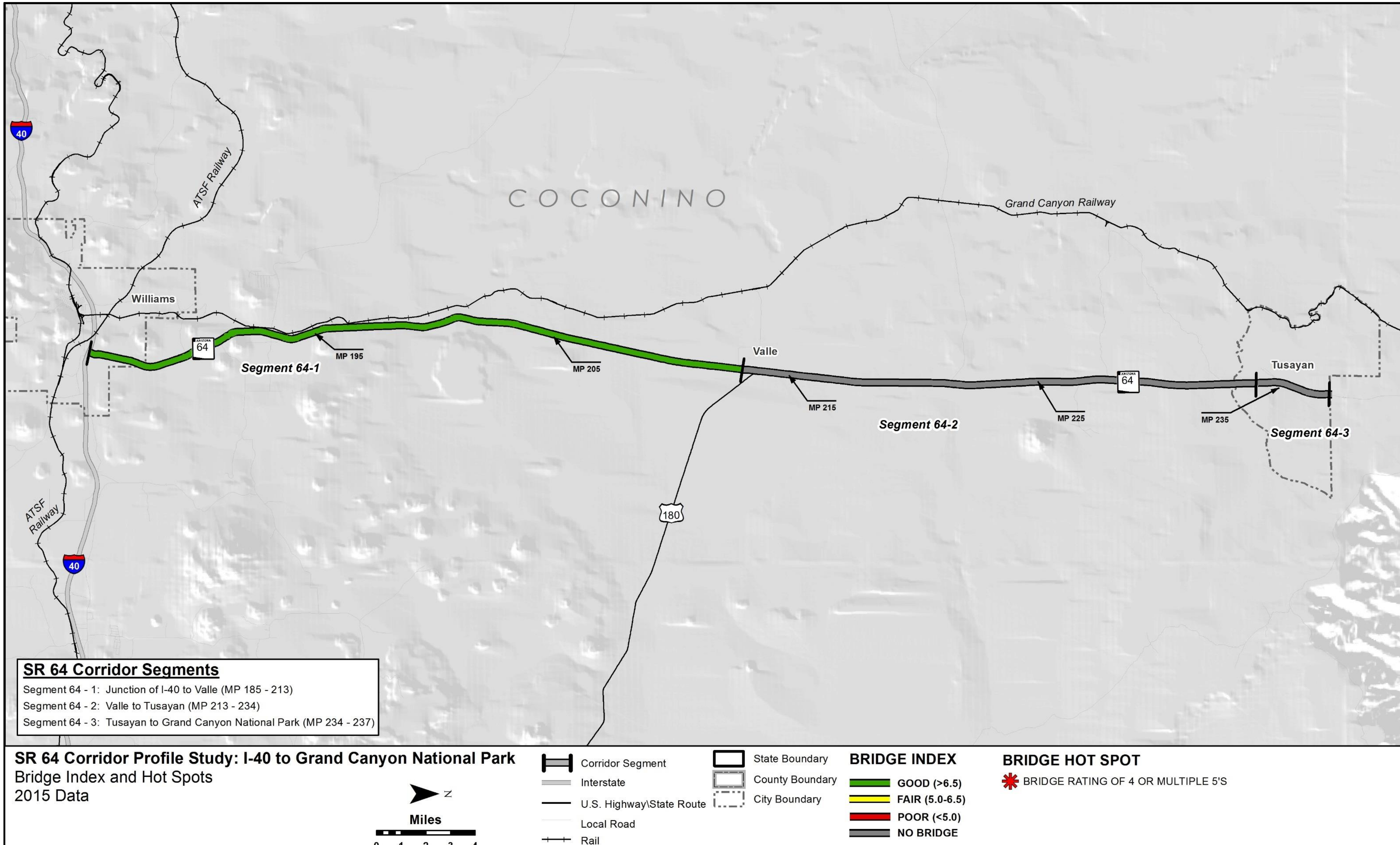
Miles
0 1 2 3 4

Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail

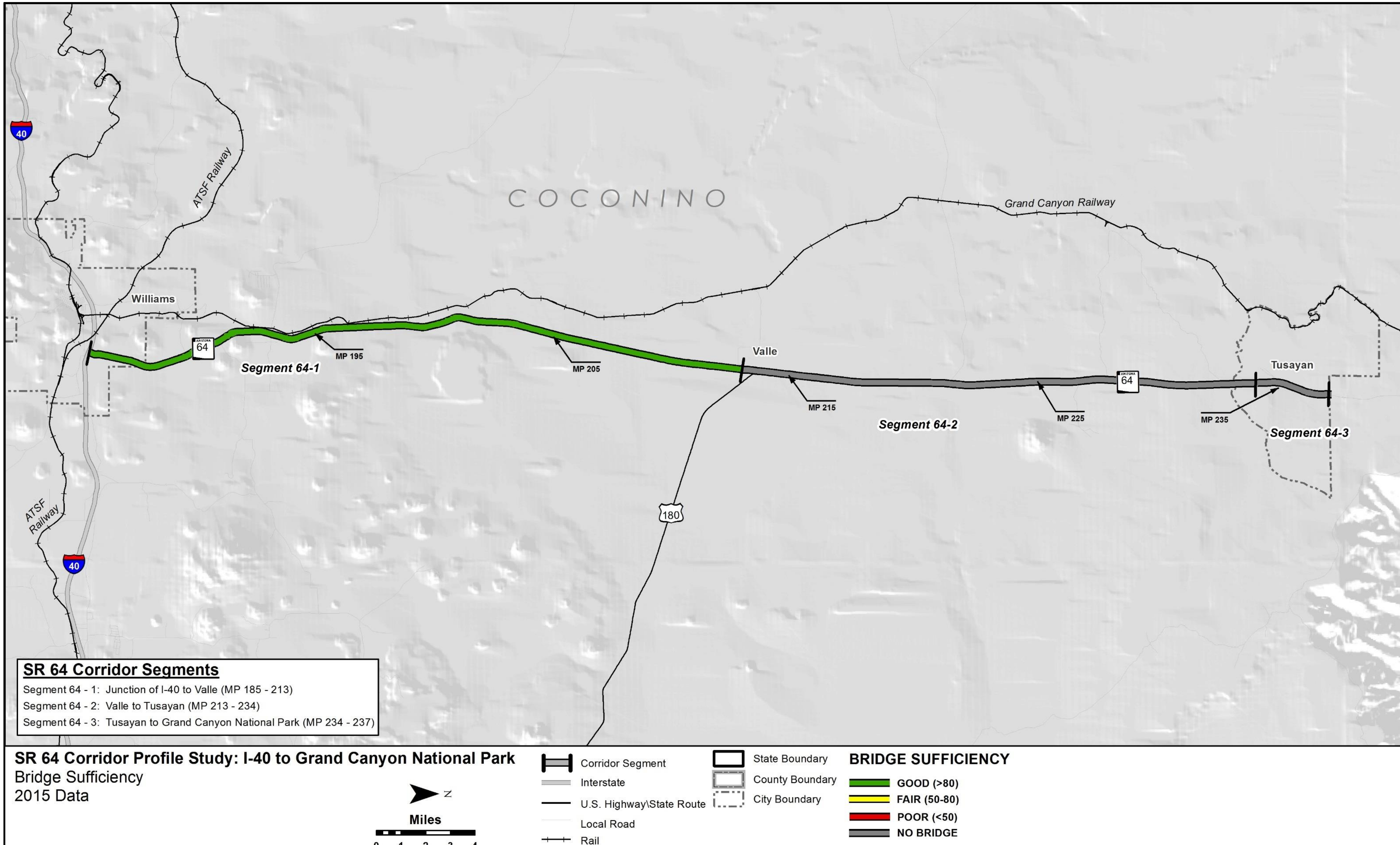
State Boundary
County Boundary
City Boundary

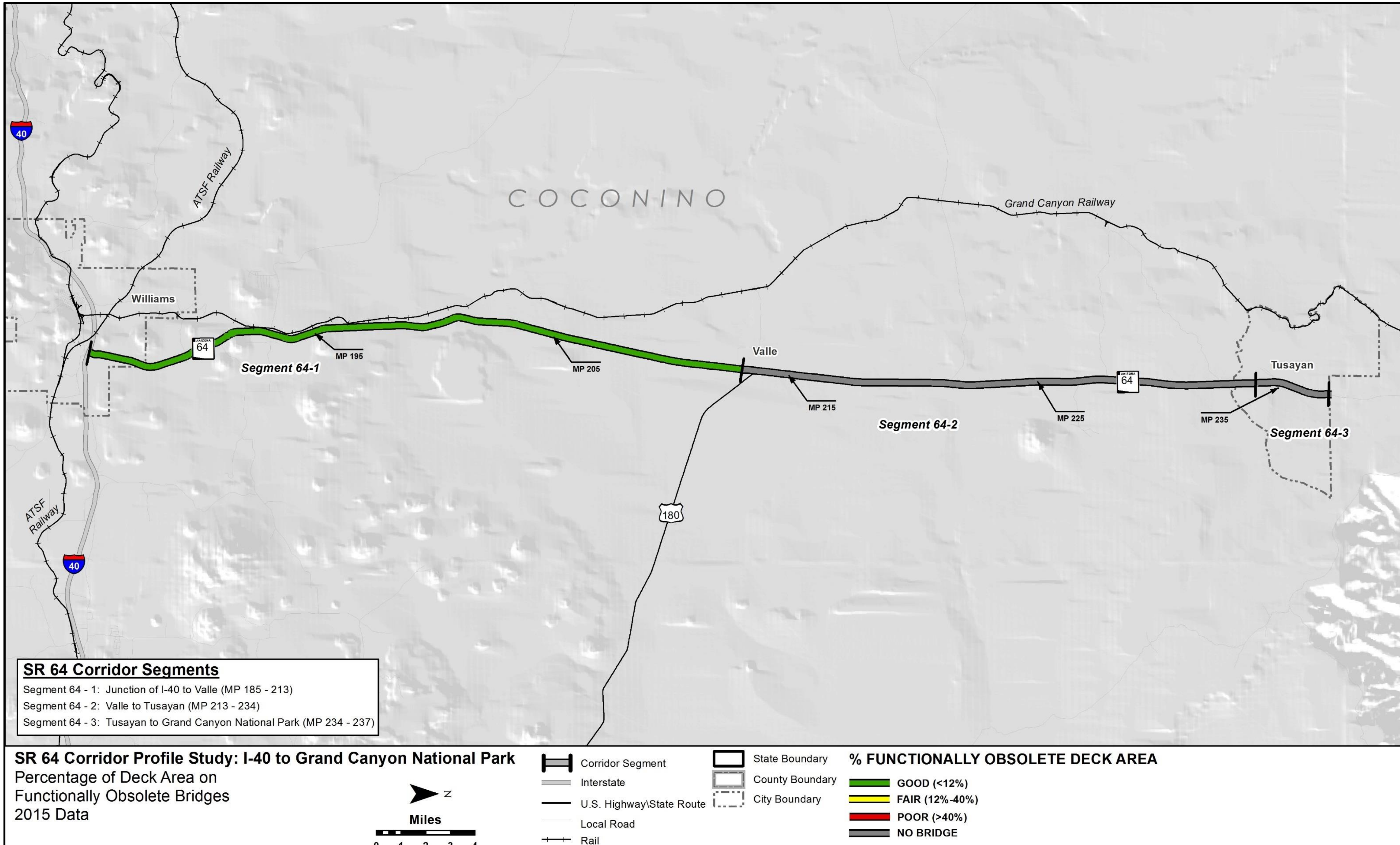
PERCENTAGE OF PAVEMENT AREA FAILURE

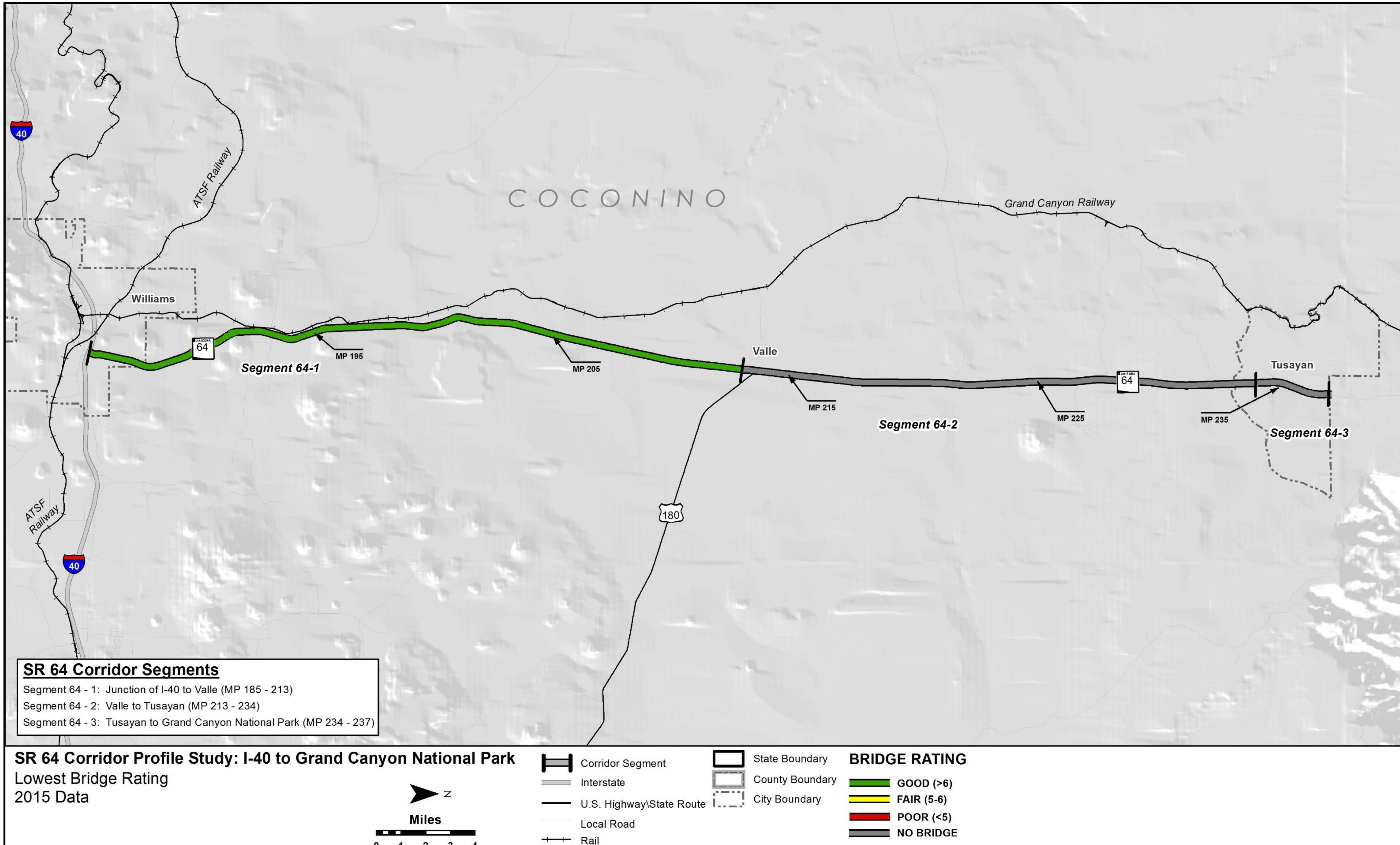
GOOD (<5%)
FAIR (5%-20%)
POOR (>20%)
NO DATA



SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Bridge Index and Hot Spots
2015 Data


COCONINO
Grand Canyon Railway
ATSF Railway
ATSF Railway
Williams
Valle
Tusayan
40
40
64
64
180
Segment 64-1
Segment 64-2
Segment 64-3
MP 195
MP 205
MP 215
MP 225
MP 235
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Bridge Sufficiency
2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
BRIDGE SUFFICIENCY
GOOD (>80)
FAIR (50-80)
POOR (<50)
NO BRIDGE


COCONINO
Williams
Valle
Tusayan
Grand Canyon Railway
ATSF Railway
ATSF Railway
40
40
64
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Percentage of Deck Area on Functionally Obsolete Bridges
2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
% FUNCTIONALLY OBSOLETE DECK AREA
GOOD (<12%)
FAIR (12%-40%)
POOR (>40%)
NO BRIDGE


COCONINO
Grand Canyon Railway
ATSF Railway
ATSF Railway
Williams
Valle
Tusayan
40
40
64
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Lowest Bridge Rating
2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
BRIDGE RATING
GOOD (>6)
FAIR (5-6)
POOR (<5)
NO BRIDGE

SR 64 Corridor Segments

Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)

SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Mobility Index
2015 Data

N
Miles
0 1 2 3 4

Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail

State Boundary
County Boundary
City Boundary

MOBILITY INDEX
RURAL
GOOD (<0.56)
FAIR (0.56-0.76)
POOR (>0.76)
NO DATA

SR 64 Corridor Segments

Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)

SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Future Daily Volume/Capacity (V/C) Ratio
2015 Data

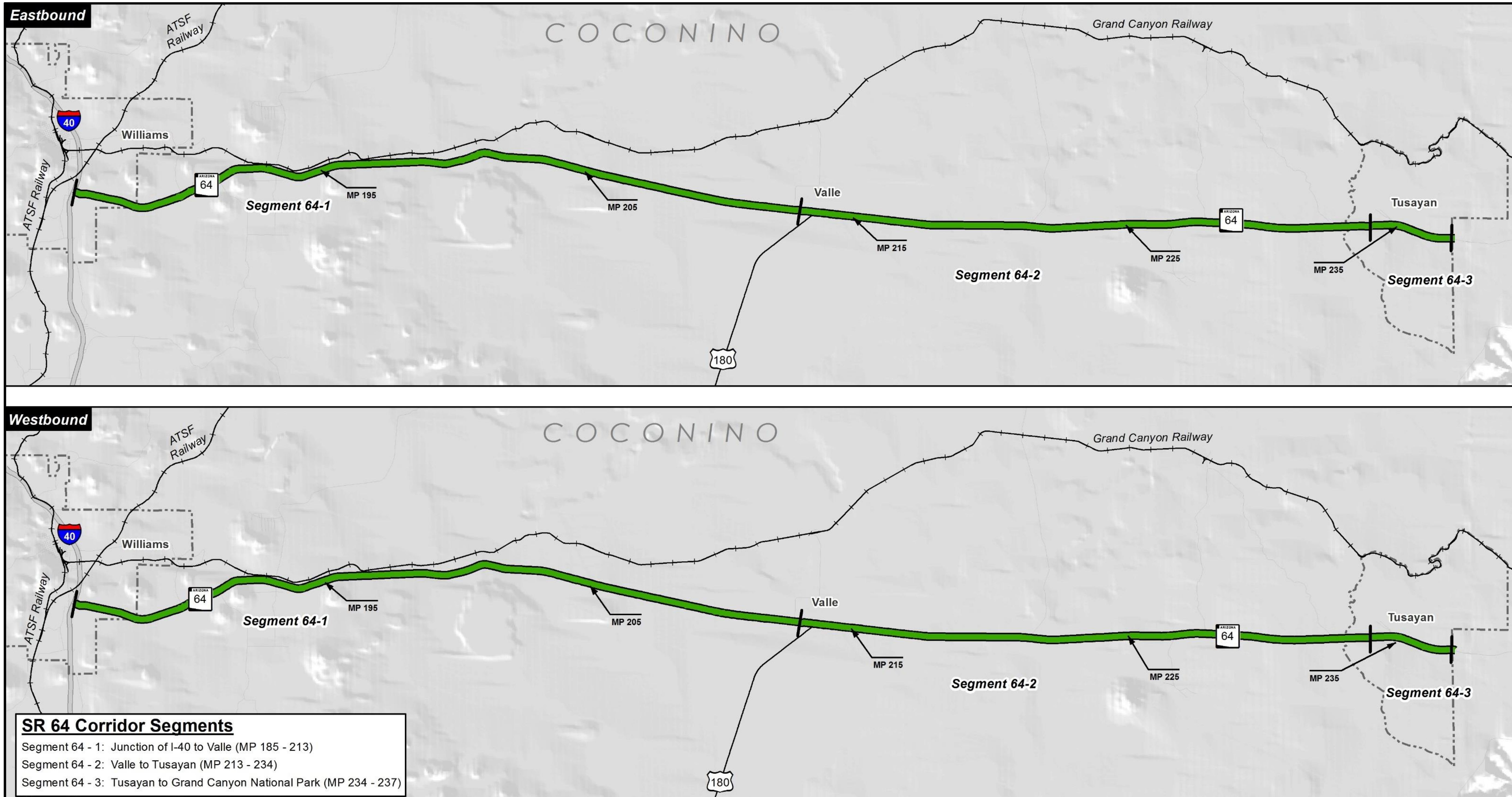
N

Miles
0 1 2 3 4

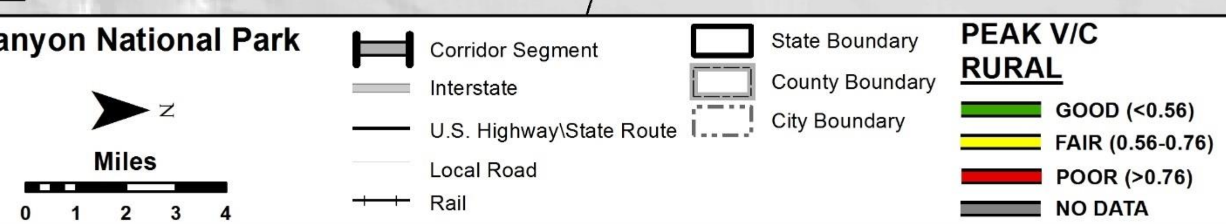
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail

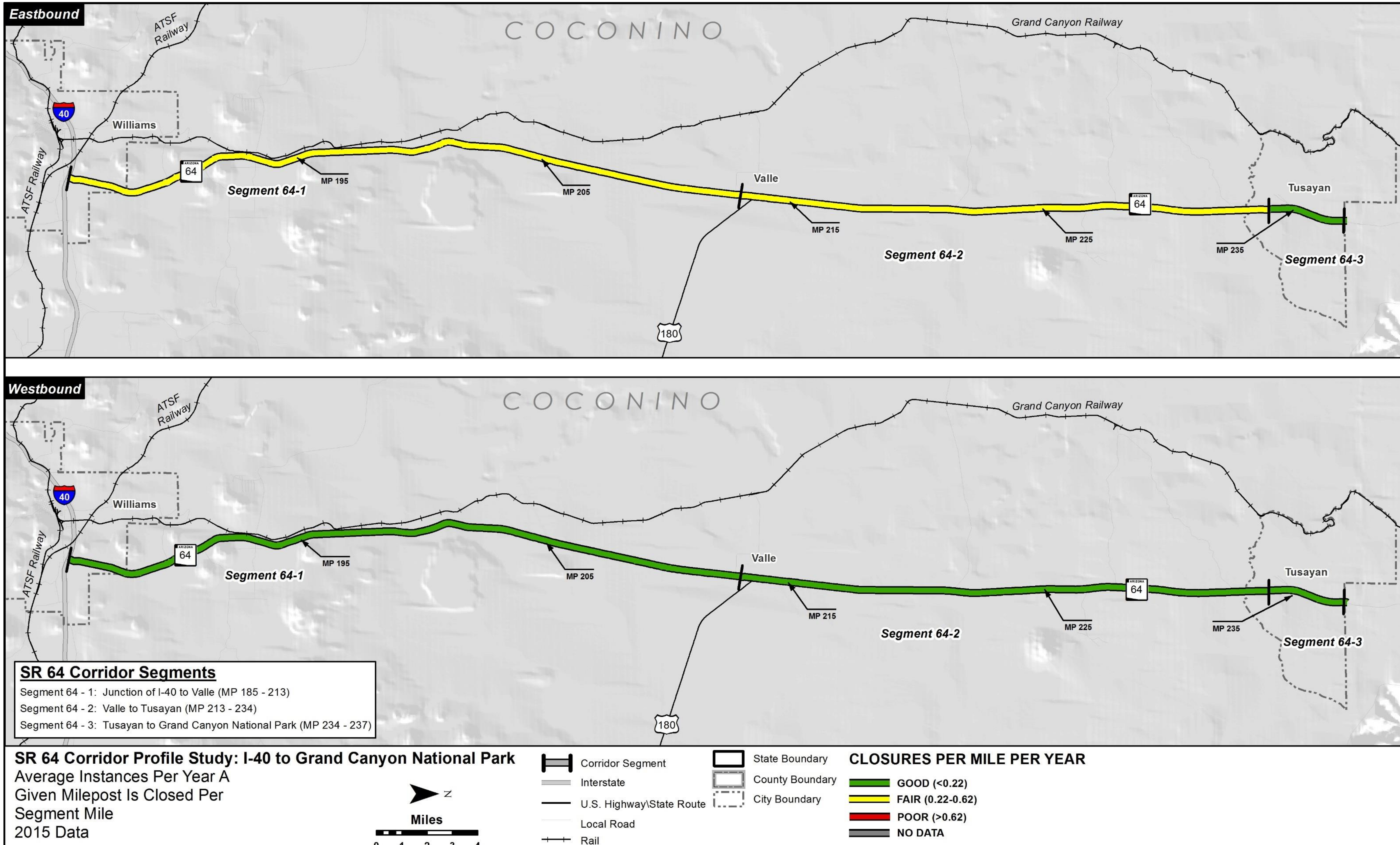
State Boundary
County Boundary
City Boundary

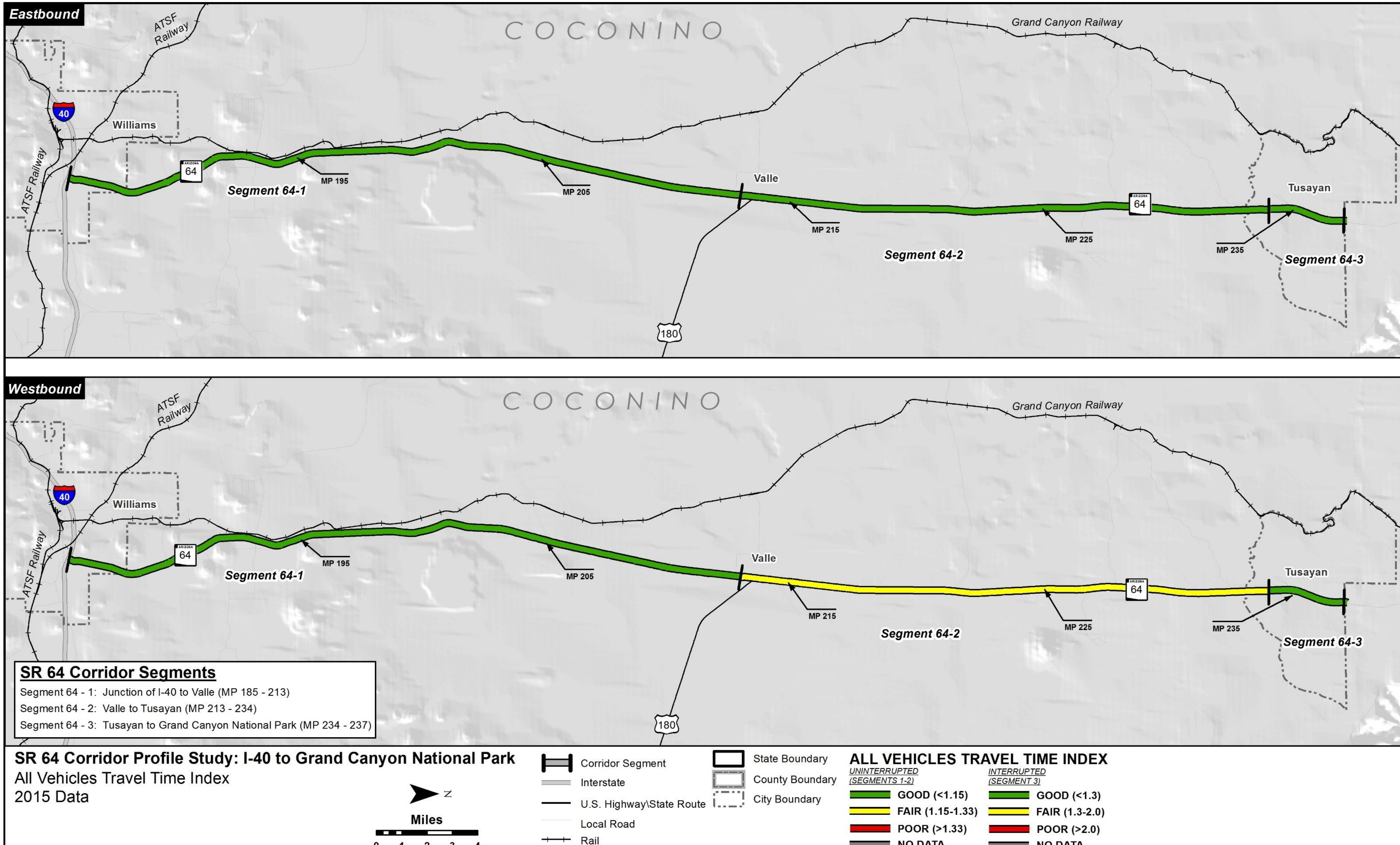
FUTURE V/C
RURAL
GOOD (<0.56)
FAIR (0.56-0.76)
POOR (>0.76)
NO DATA



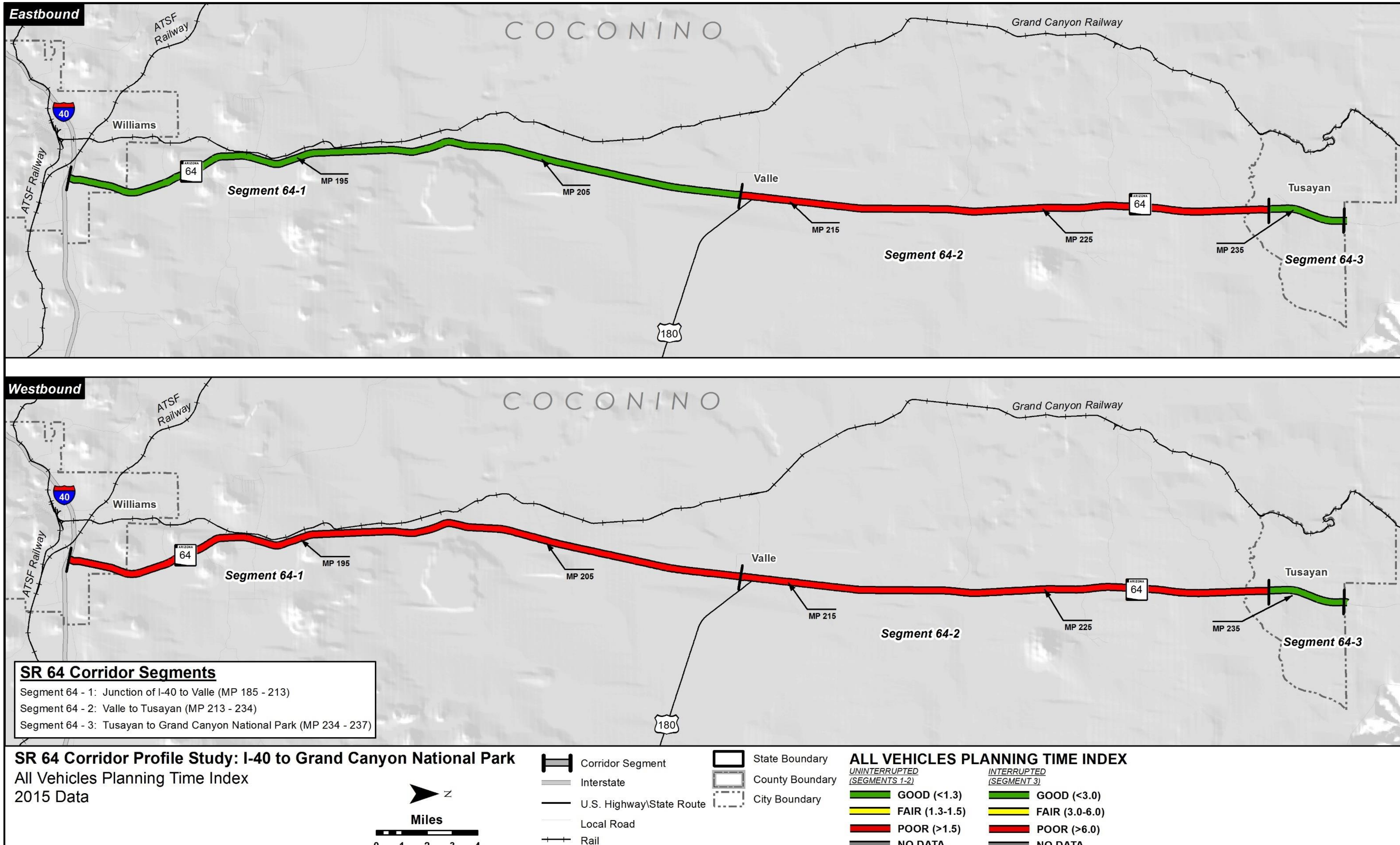
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Existing Peak Hour V/C
2015 Data

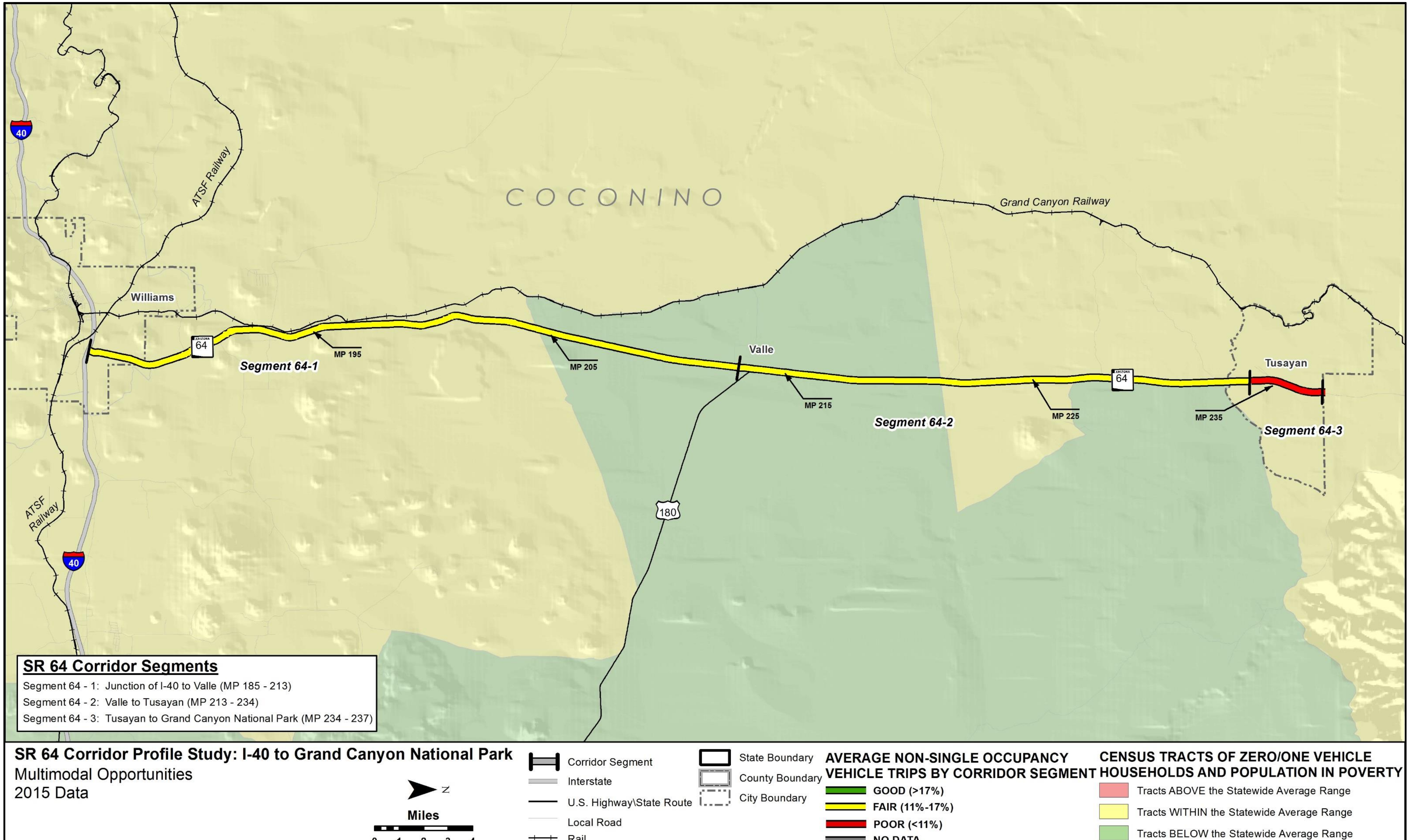


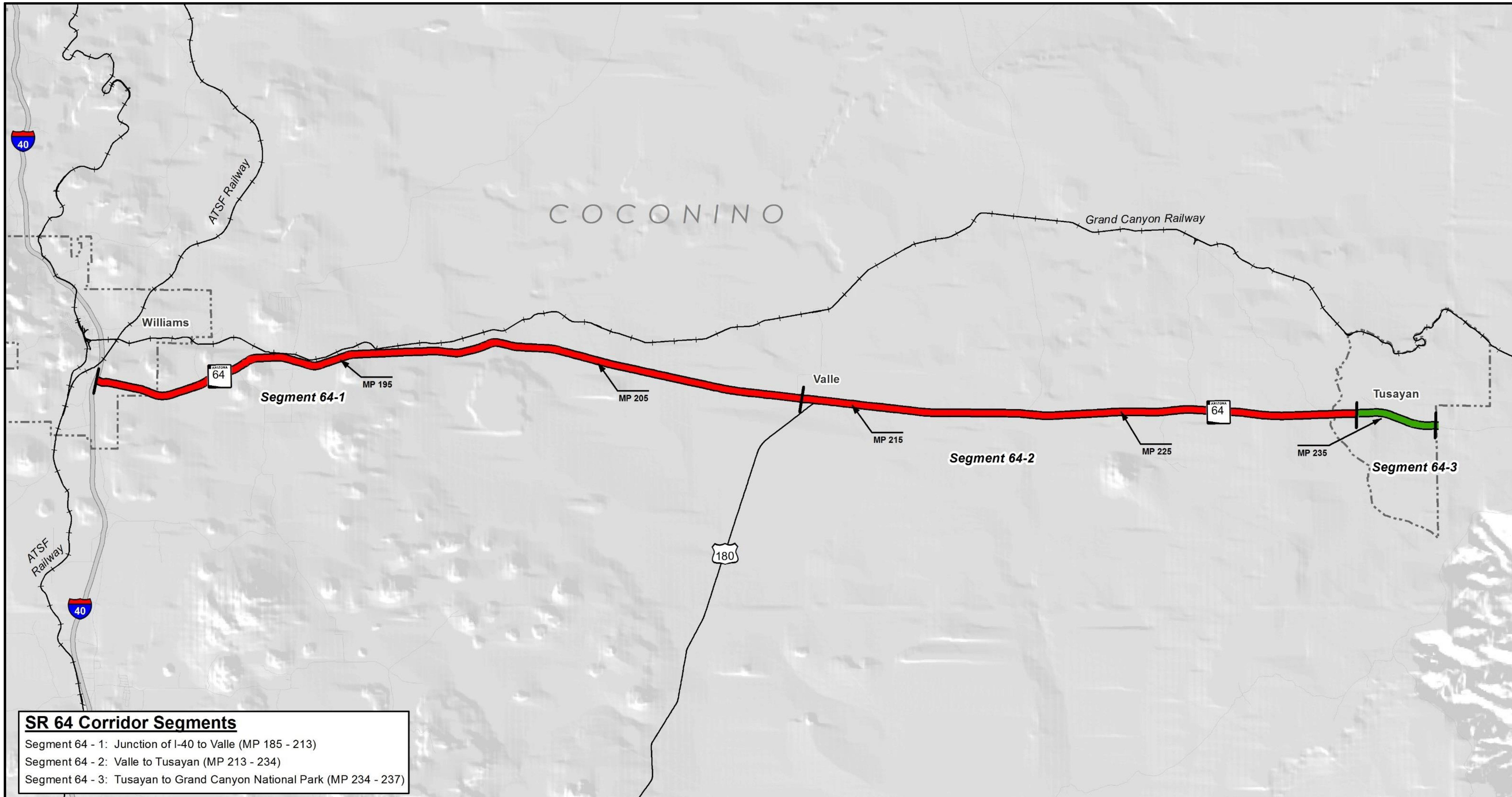

Eastbound
COCONINO
ATSF Railway
Grand Canyon Railway
Williams
40
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
MP 235
Tusayan
Segment 64-3
180
Westbound
COCONINO
ATSF Railway
Grand Canyon Railway
Williams
40
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
MP 235
Tusayan
Segment 64-3
180
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Average Instances Per Year A
Given Milepost Is Closed Per
Segment Mile
2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
CLOSURES PER MILE PER YEAR
GOOD (<0.22)
FAIR (0.22-0.62)
POOR (>0.62)
NO DATA



Eastbound
COCONINO
ATSF Railway
Grand Canyon Railway
40
Williams
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
MP 225
MP 235
Tusayan
Segment 64-2
Segment 64-3
180
Westbound
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
All Vehicles Travel Time Index
2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
ALL VEHICLES TRAVEL TIME INDEX
UNINTERRUPTED (SEGMENTS 1-2)
GOOD (<1.15)
FAIR (1.15-1.33)
POOR (>1.33)
NO DATA
INTERRUPTED (SEGMENT 3)
GOOD (<1.3)
FAIR (1.3-2.0)
POOR (>2.0)
NO DATA


Eastbound
COCONINO
ATSF Railway
Grand Canyon Railway
Williams
40
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
MP 235
Tusayan
Segment 64-3
180
Westbound
COCONINO
ATSF Railway
Grand Canyon Railway
Williams
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
MP 235
Tusayan
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
All Vehicles Planning Time Index
2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
ALL VEHICLES PLANNING TIME INDEX
UNINTERRUPTED (SEGMENTS 1-2)
GOOD (<1.3)
FAIR (1.3-1.5)
POOR (>1.5)
NO DATA
INTERRUPTED (SEGMENT 3)
GOOD (<3.0)
FAIR (3.0-6.0)
POOR (>6.0)
NO DATA


COCONINO
Williams
Valle
Tusayan
Grand Canyon Railway
ATSF Railway
ATSF Railway
40
40
64
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Multimodal Opportunities
2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
AVERAGE NON-SINGLE OCCUPANCY VEHICLE TRIPS BY CORRIDOR SEGMENT
GOOD (>17%)
FAIR (11%-17%)
POOR (<11%)
NO DATA
CENSUS TRACTS OF ZERO/ONE VEHICLE HOUSEHOLDS AND POPULATION IN POVERTY
Tracts ABOVE the Statewide Average Range
Tracts WITHIN the Statewide Average Range
Tracts BELOW the Statewide Average Range



SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park

Percentage of Bicycle Accommodation

2015 Data

N

Miles

0 1 2 3 4

Corridor Segment

Interstate

U.S. Highway\State Route

Local Road

Rail

State Boundary

County Boundary

City Boundary

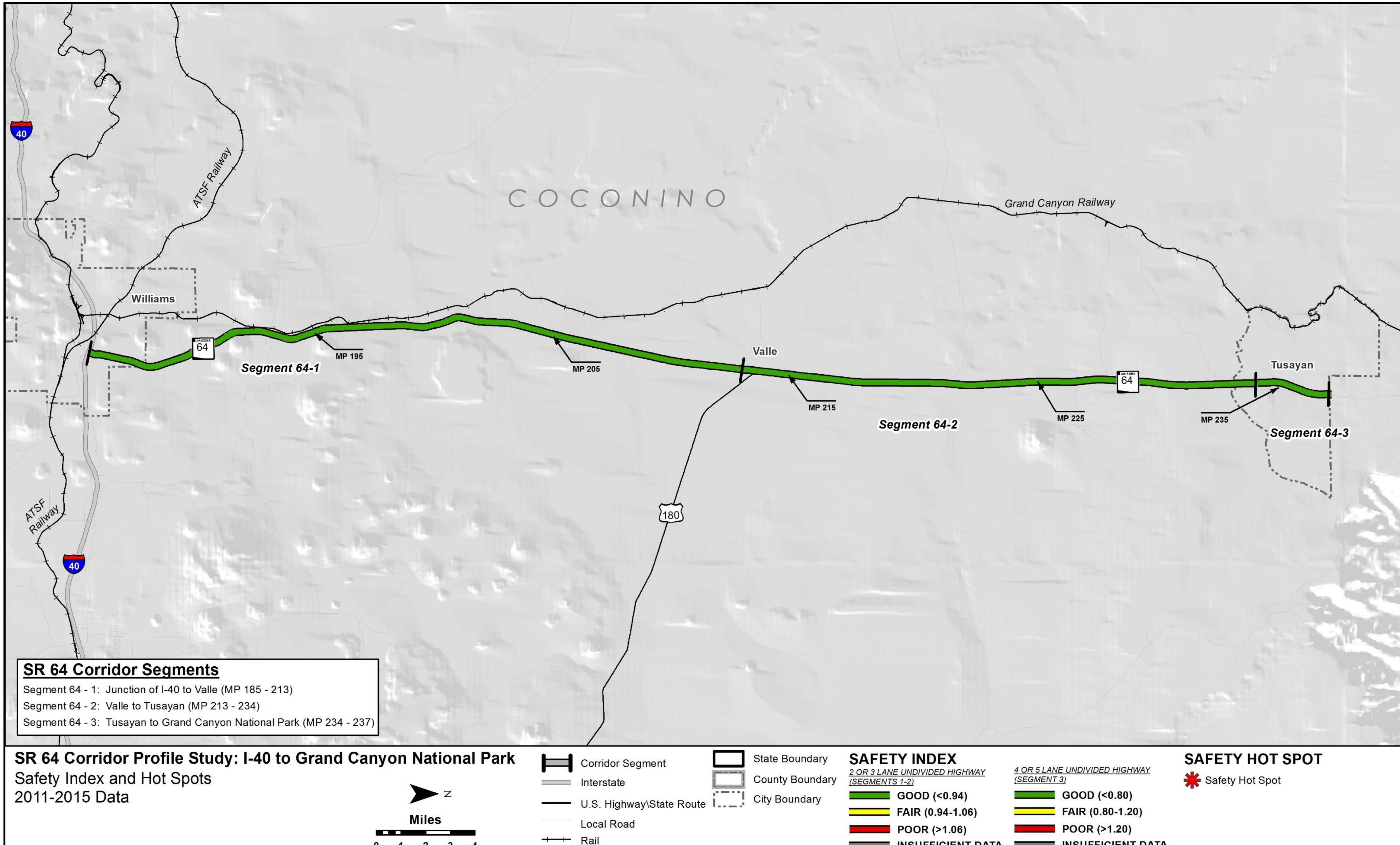
% BICYCLE ACCOMODATION

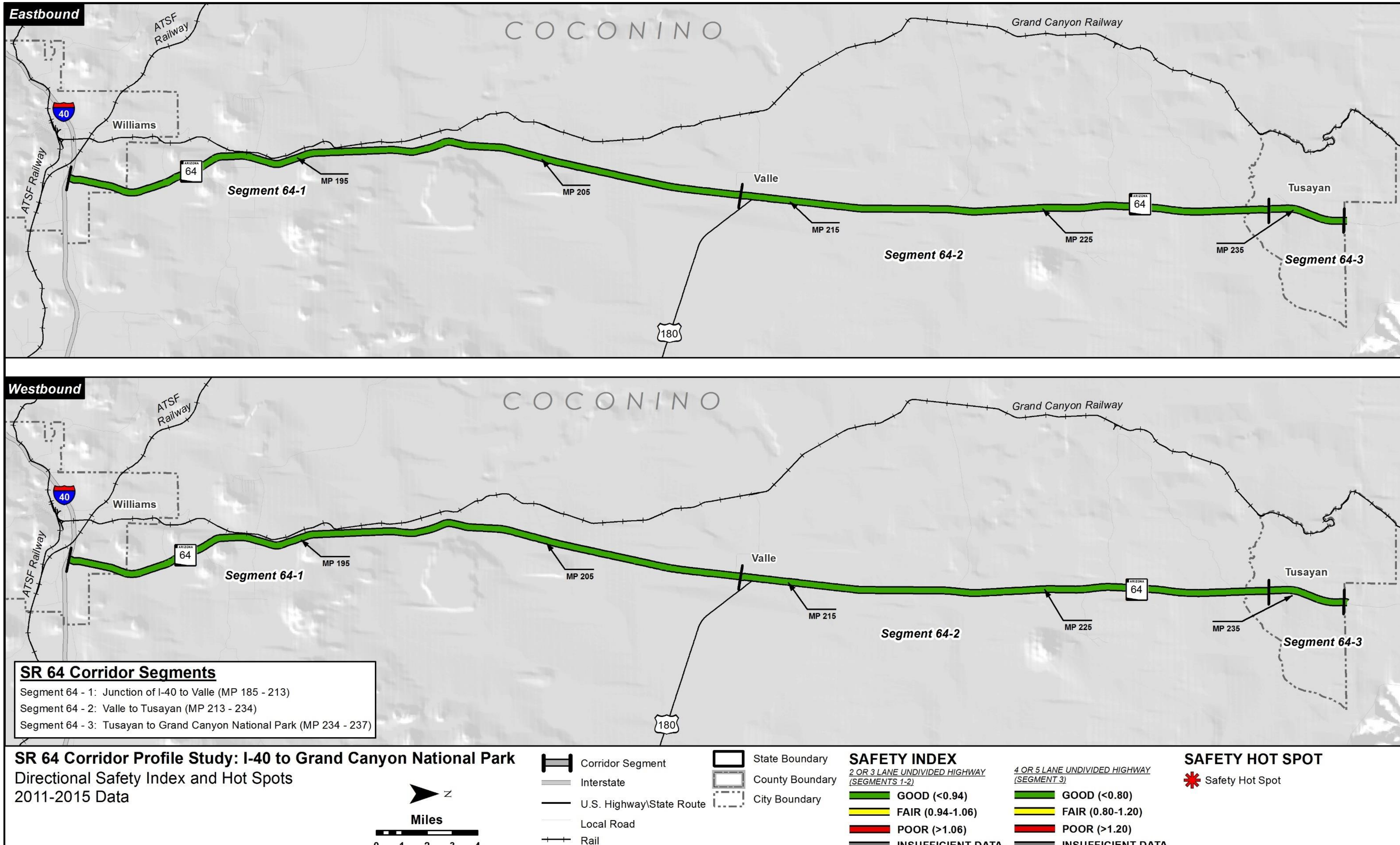
GOOD (>90%)

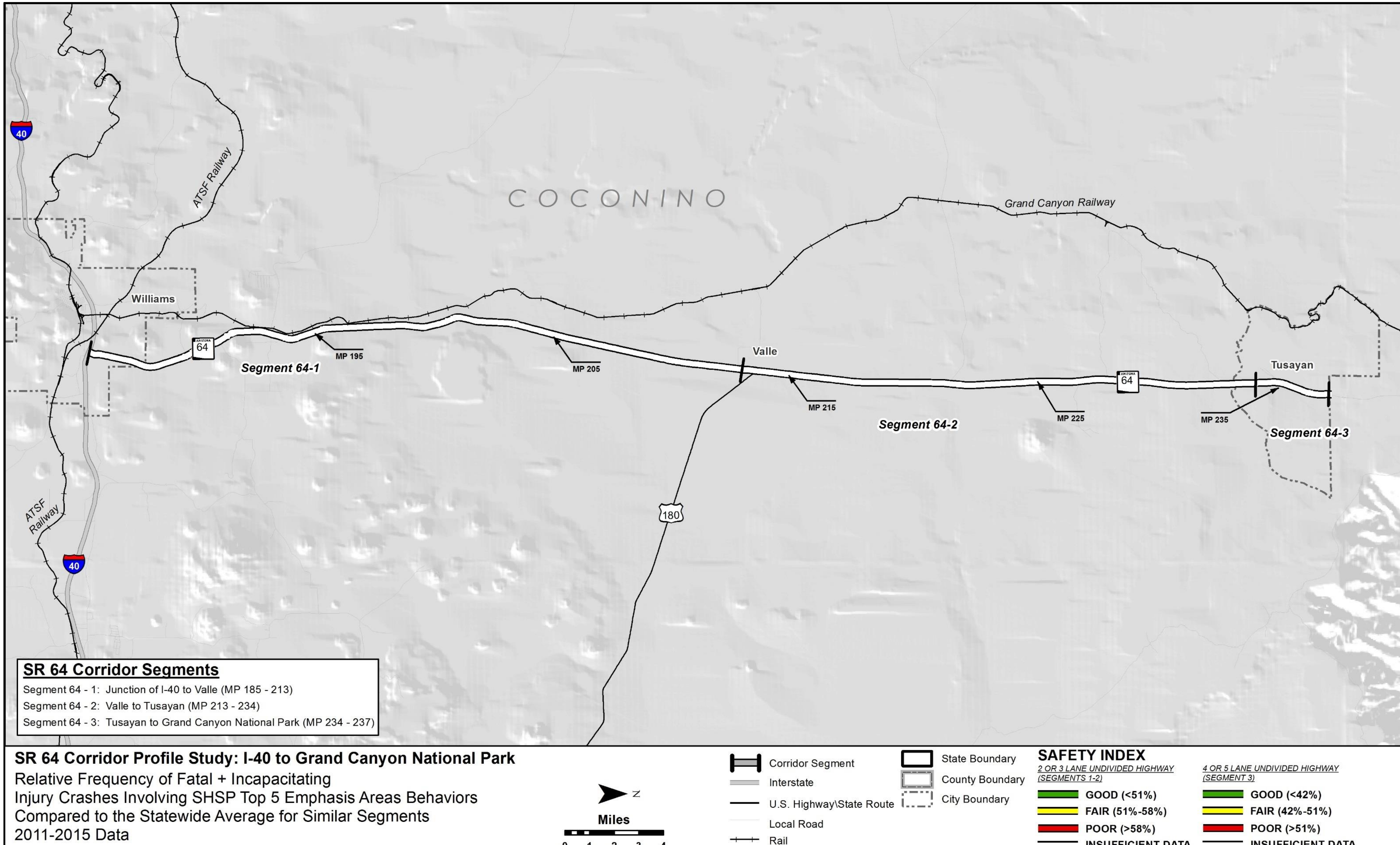
FAIR (60%-90%)

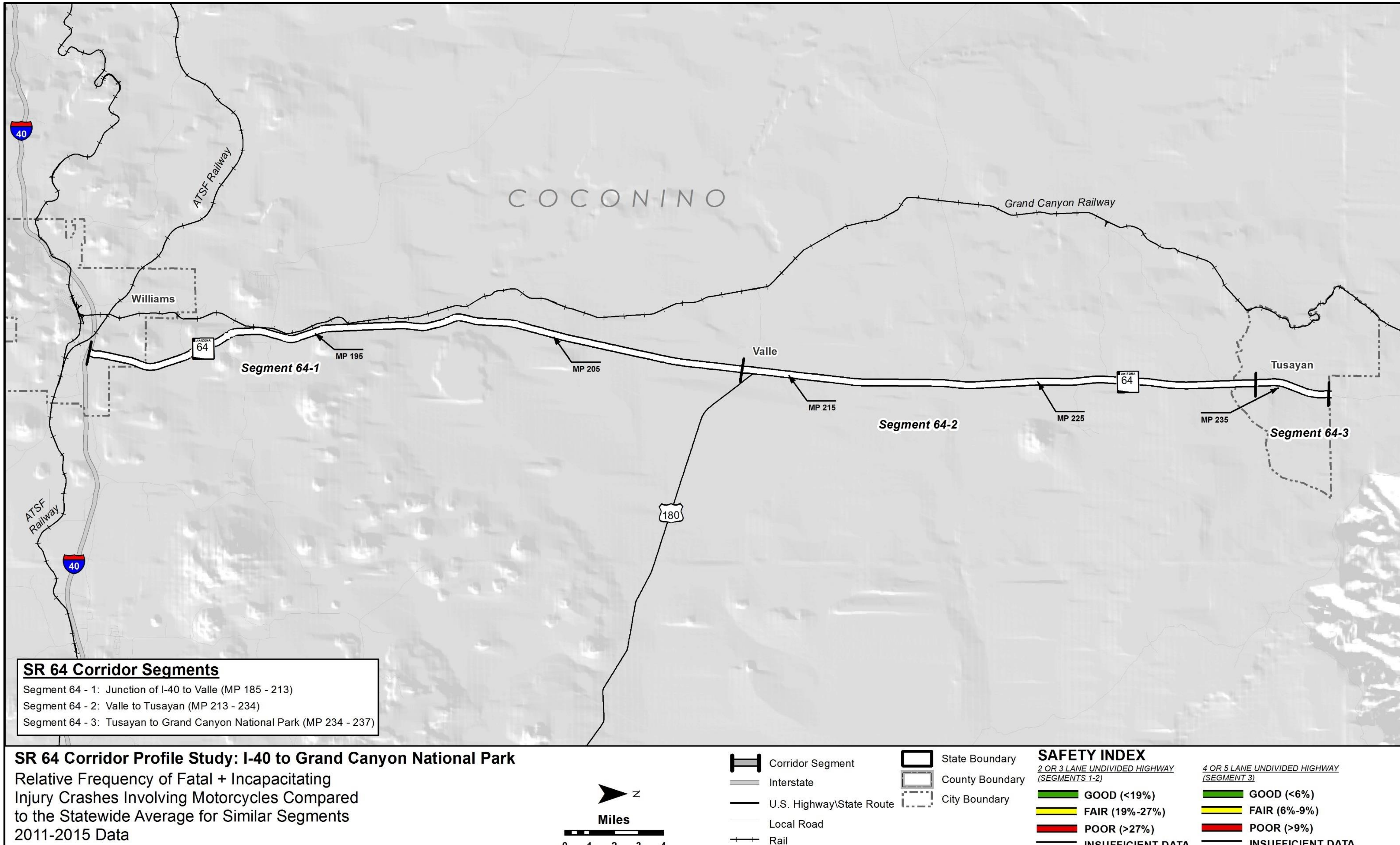
POOR (<60%)

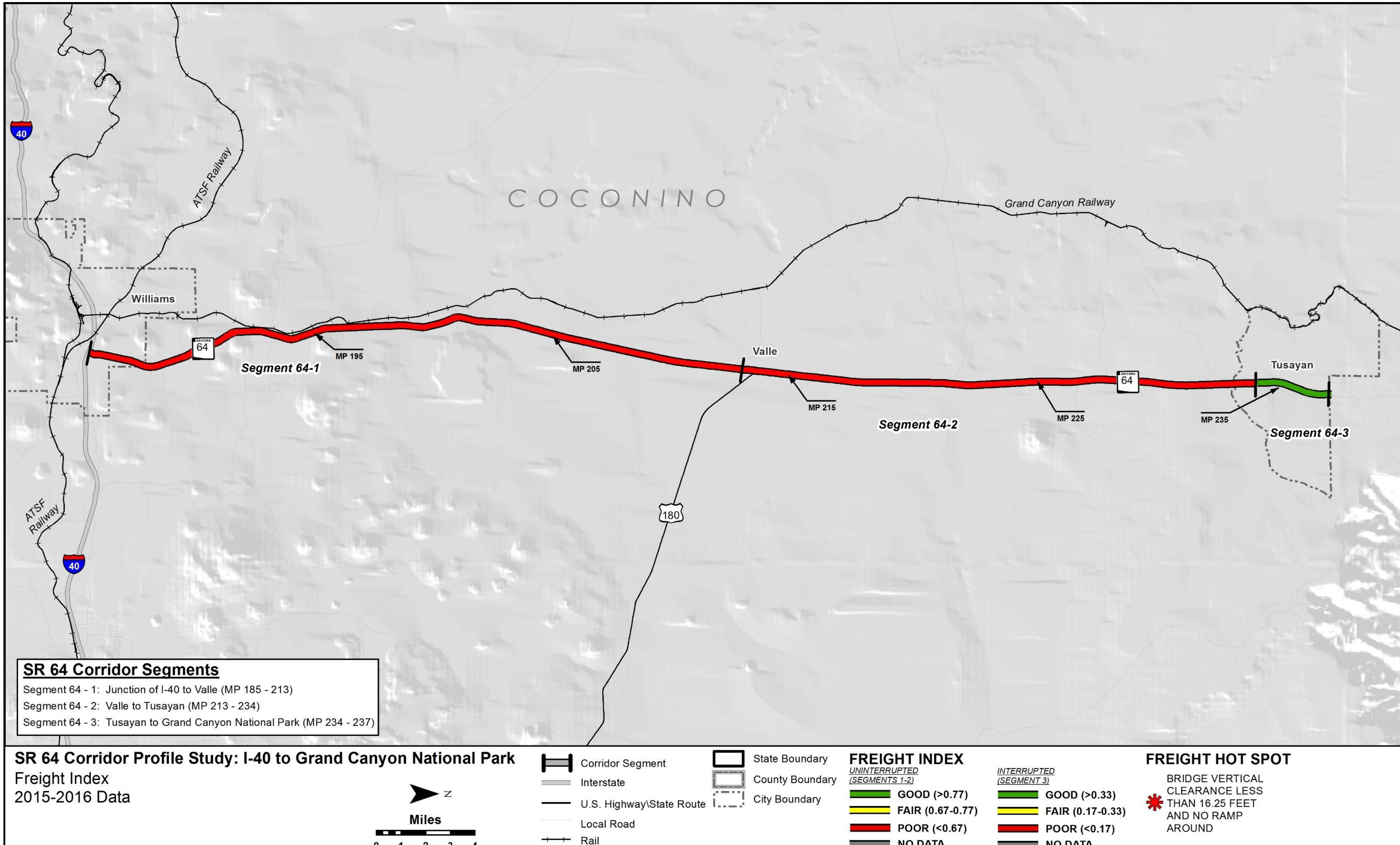
NO DATA

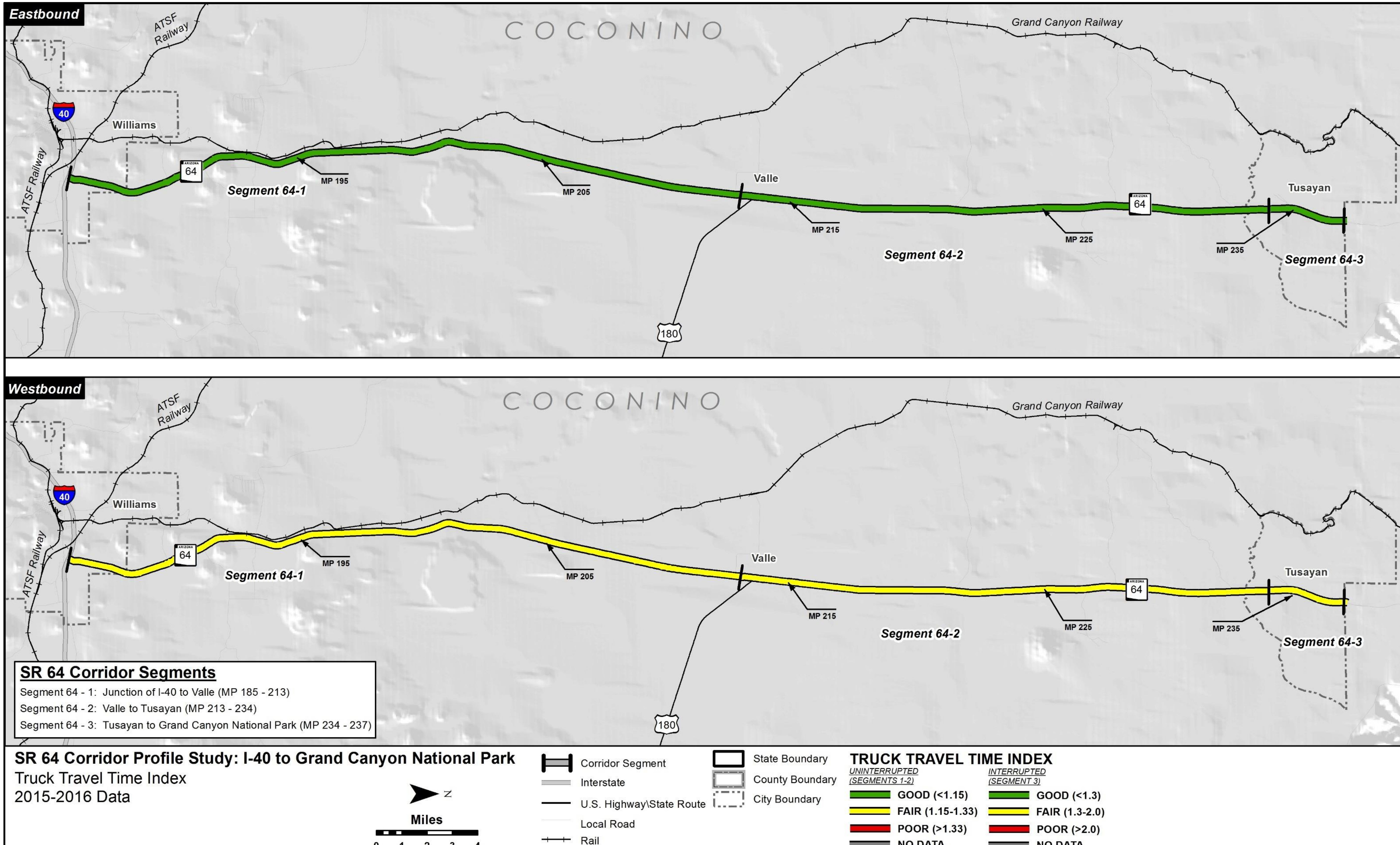

COCONINO
Williams
ATSF Railway
ATSF Railway
Grand Canyon Railway
Valle
Tusayan
40
40
64
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Safety Index and Hot Spots
2011-2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
SAFETY INDEX
2 OR 3 LANE UNDIVIDED HIGHWAY (SEGMENTS 1-2)
GOOD (<0.94)
FAIR (0.94-1.06)
POOR (>1.06)
INSUFFICIENT DATA
4 OR 5 LANE UNDIVIDED HIGHWAY (SEGMENT 3)
GOOD (<0.80)
FAIR (0.80-1.20)
POOR (>1.20)
INSUFFICIENT DATA
SAFETY HOT SPOT
Safety Hot Spot


Eastbound
COCONINO
ATSF Railway
Grand Canyon Railway
40
Williams
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
Tusayan
MP 235
Segment 64-3
180
Westbound
COCONINO
ATSF Railway
Grand Canyon Railway
40
Williams
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
Tusayan
MP 235
Segment 64-3
180
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Directional Safety Index and Hot Spots
2011-2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
SAFETY INDEX
2 OR 3 LANE UNDIVIDED HIGHWAY (SEGMENTS 1-2)
GOOD (<0.94)
FAIR (0.94-1.06)
POOR (>1.06)
INSUFFICIENT DATA
4 OR 5 LANE UNDIVIDED HIGHWAY (SEGMENT 3)
GOOD (<0.80)
FAIR (0.80-1.20)
POOR (>1.20)
INSUFFICIENT DATA
SAFETY HOT SPOT
Safety Hot Spot

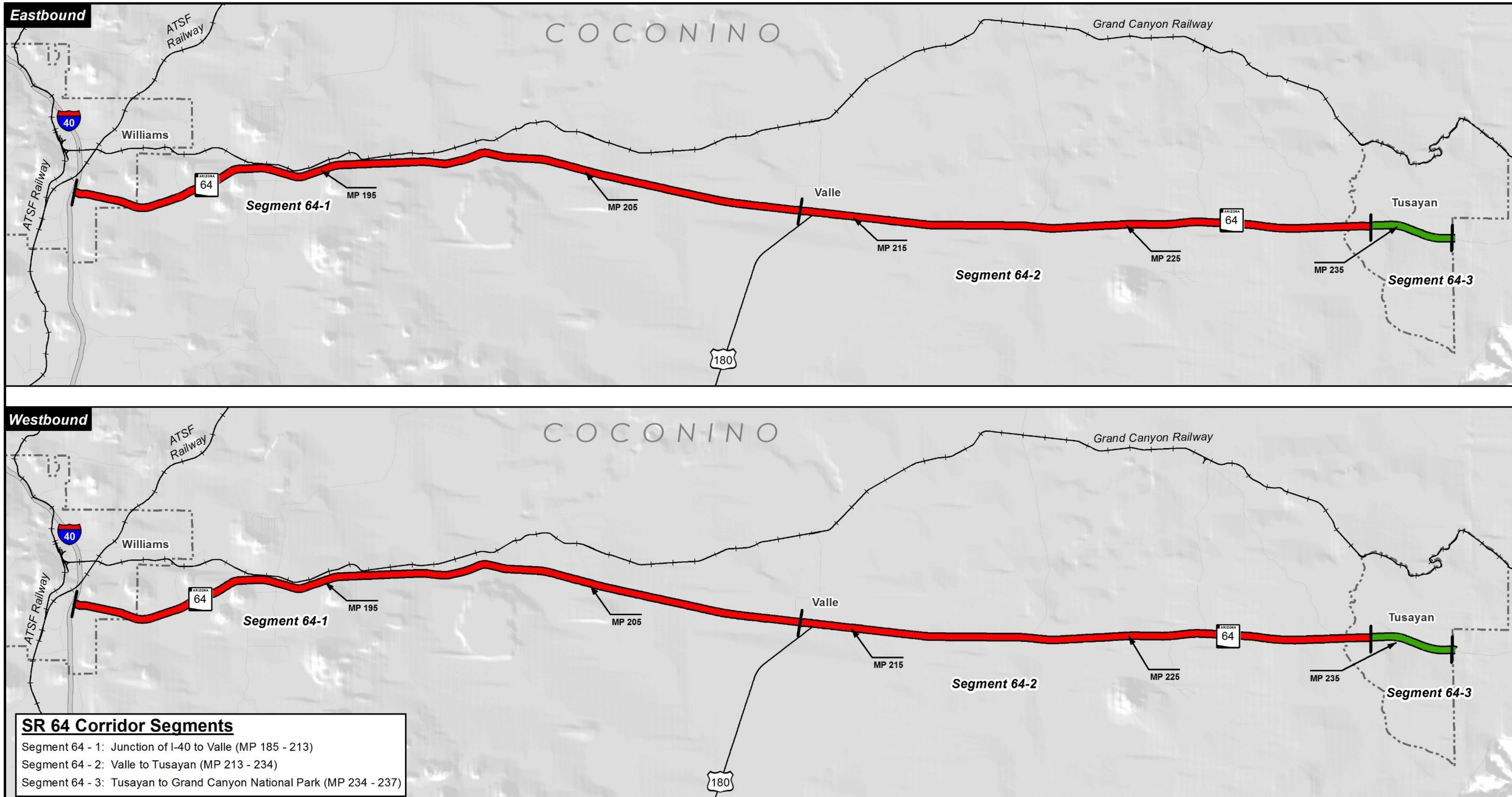

COCONINO
Grand Canyon Railway
ATSF Railway
ATSF Railway
Williams
Valle
Tusayan
40
40
64
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Relative Frequency of Fatal + Incapacitating
Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors
Compared to the Statewide Average for Similar Segments
2011-2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
SAFETY INDEX
2 OR 3 LANE UNDIVIDED HIGHWAY (SEGMENTS 1-2)
GOOD (<51%)
FAIR (51%-58%)
POOR (>58%)
INSUFFICIENT DATA
4 OR 5 LANE UNDIVIDED HIGHWAY (SEGMENT 3)
GOOD (<42%)
FAIR (42%-51%)
POOR (>51%)
INSUFFICIENT DATA


COCONINO
Williams
ATSF Railway
ATSF Railway
Grand Canyon Railway
Valle
Tusayan
40
40
64
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Relative Frequency of Fatal + Incapacitating Injury Crashes Involving Motorcycles Compared to the Statewide Average for Similar Segments
2011-2015 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
SAFETY INDEX
2 OR 3 LANE UNDIVIDED HIGHWAY (SEGMENTS 1-2)
GOOD (<19%)
FAIR (19%-27%)
POOR (>27%)
INSUFFICIENT DATA
4 OR 5 LANE UNDIVIDED HIGHWAY (SEGMENT 3)
GOOD (<6%)
FAIR (6%-9%)
POOR (>9%)
INSUFFICIENT DATA


COCONINO
Grand Canyon Railway
ATSF Railway
ATSF Railway
Williams
40
40
64
64
180
Valle
Tusayan
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Freight Index
2015-2016 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
FREIGHT INDEX
UNINTERRUPTED (SEGMENTS 1-2)
GOOD (>0.77)
FAIR (0.67-0.77)
POOR (<0.67)
NO DATA
INTERRUPTED (SEGMENT 3)
GOOD (>0.33)
FAIR (0.17-0.33)
POOR (<0.17)
NO DATA
FREIGHT HOT SPOT
BRIDGE VERTICAL CLEARANCE LESS THAN 16.25 FEET AND NO RAMP AROUND



Eastbound
COCONINO
ATSF Railway
Grand Canyon Railway
Williams
Valle
Tusayan
40
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
Westbound
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Truck Travel Time Index
2015-2016 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
TRUCK TRAVEL TIME INDEX
UNINTERRUPTED (SEGMENTS 1-2)
GOOD (<1.15)
FAIR (1.15-1.33)
POOR (>1.33)
NO DATA
INTERRUPTED (SEGMENT 3)
GOOD (<1.3)
FAIR (1.3-2.0)
POOR (>2.0)
NO DATA



SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park

Truck Planning Time Index

2015-2016 Data

N

Miles

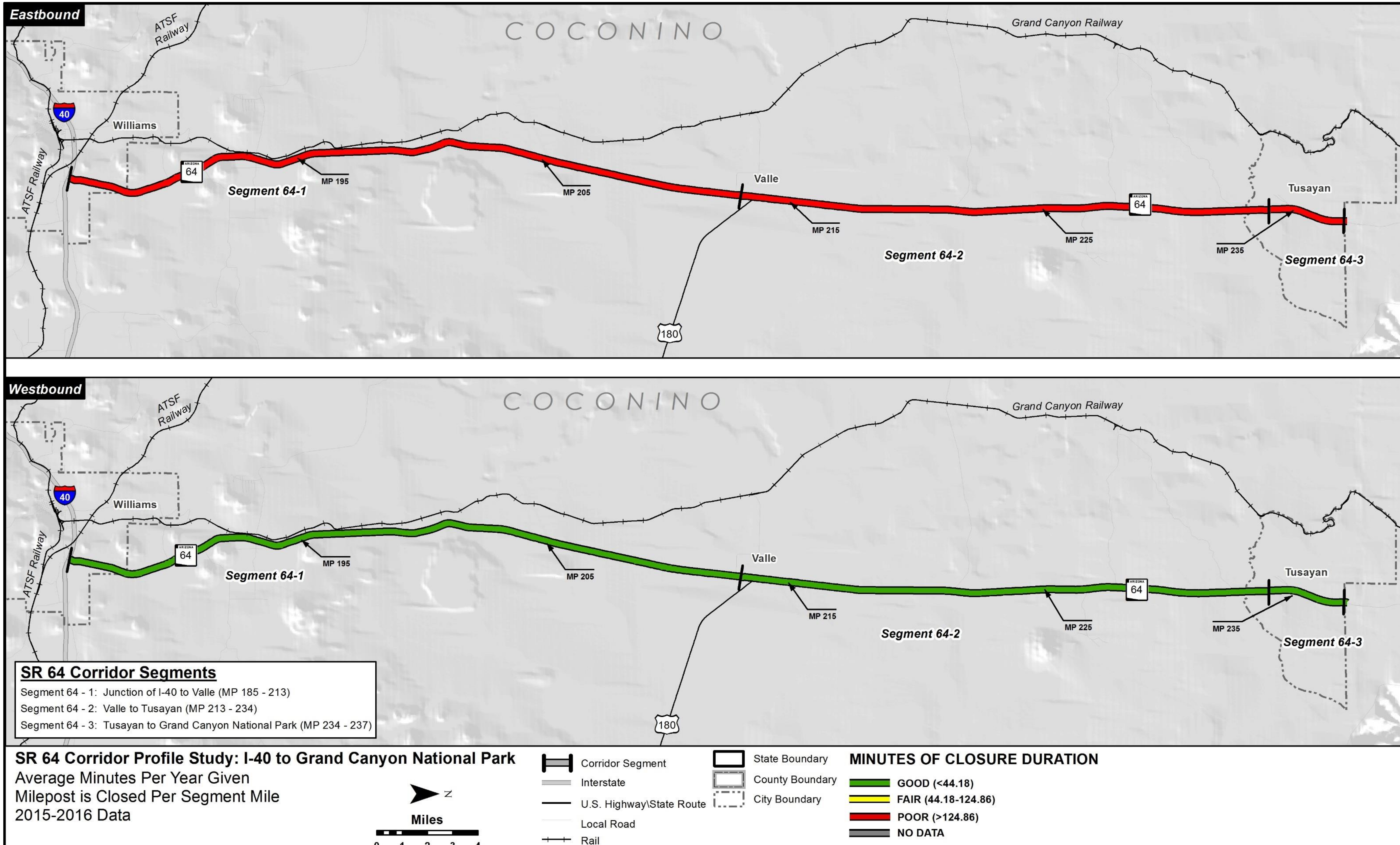
0 1 2 3 4

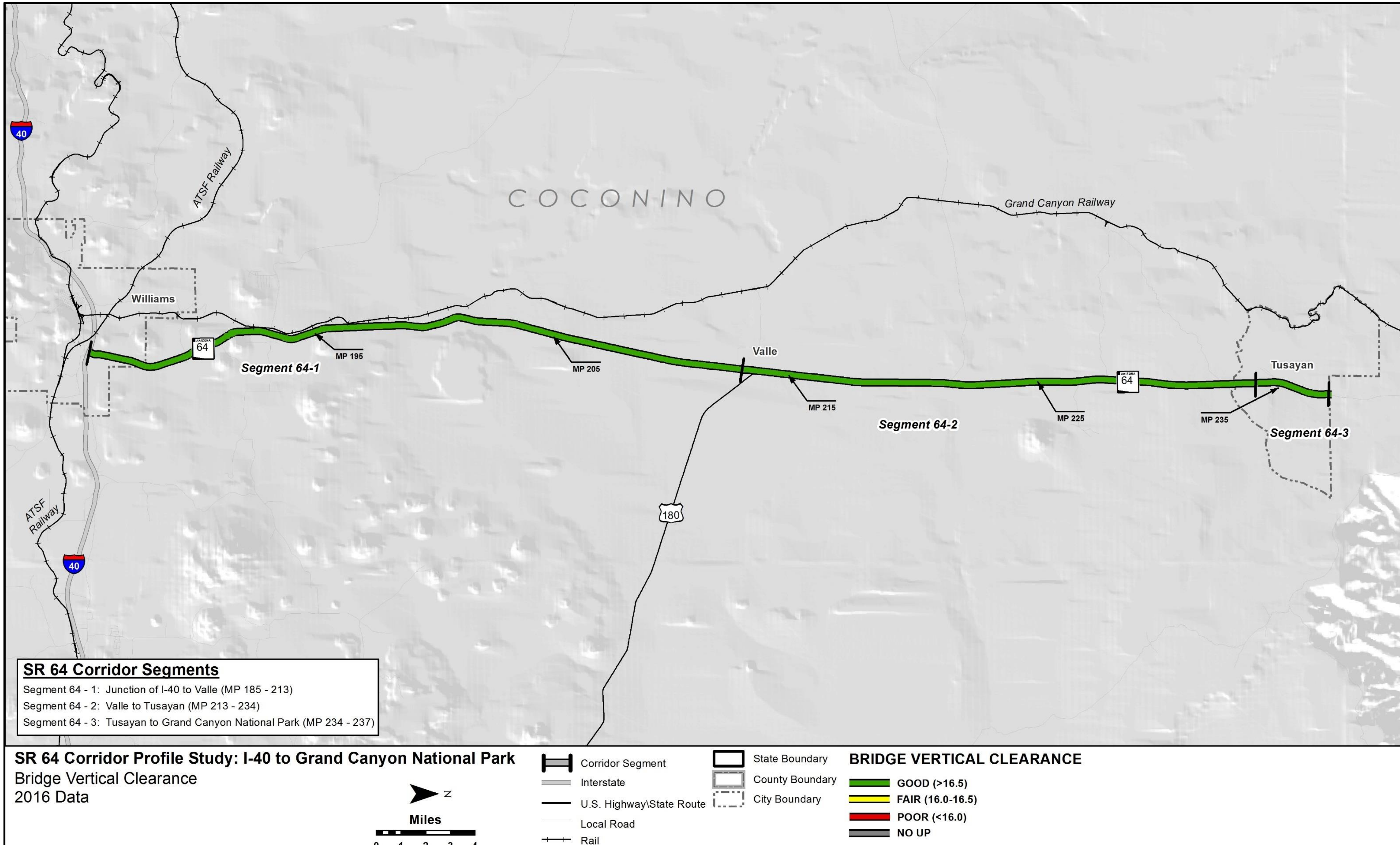
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail

State Boundary
County Boundary
City Boundary

TRUCK PLANNING TIME INDEX

UNINTERRUPTED (SEGMENTS 1-2)	INTERRUPTED (SEGMENT 3)
GOOD (<1.3)	GOOD (<3.0)
FAIR (1.3-1.5)	FAIR (3.0-6.0)
POOR (>1.5)	POOR (>6.0)
NO DATA	NO DATA

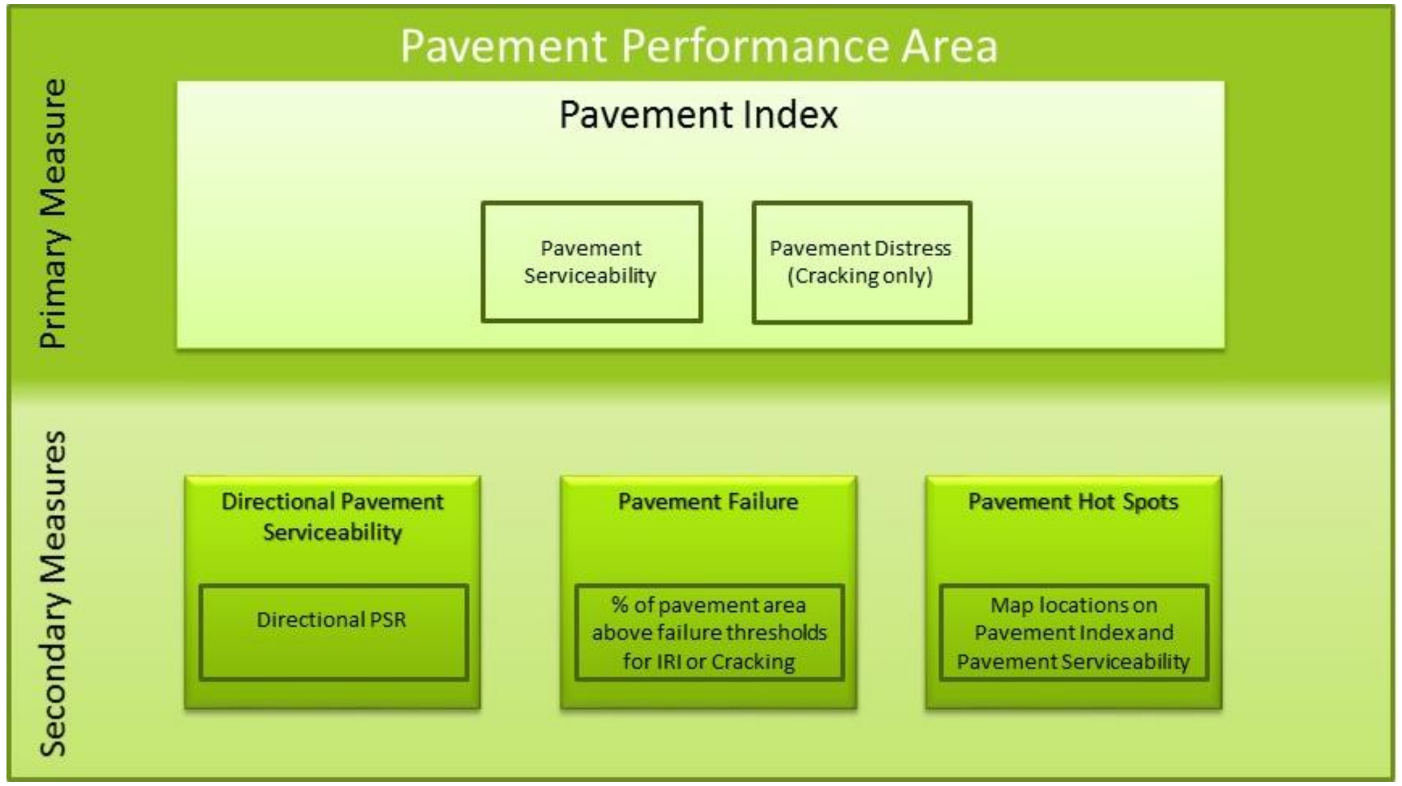

Eastbound
COCONINO
ATSF Railway
Grand Canyon Railway
40
Williams
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
64
Tusayan
MP 235
Segment 64-3
180
ATSF Railway
Westbound
COCONINO
ATSF Railway
Grand Canyon Railway
40
Williams
64
Segment 64-1
MP 195
MP 205
Valle
MP 215
Segment 64-2
MP 225
64
Tusayan
MP 235
Segment 64-3
180
ATSF Railway
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Average Minutes Per Year Given
Milepost is Closed Per Segment Mile
2015-2016 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
MINUTES OF CLOSURE DURATION
GOOD (<44.18)
FAIR (44.18-124.86)
POOR (>124.86)
NO DATA


COCONINO
Williams
Valle
Tusayan
ATSF Railway
ATSF Railway
Grand Canyon Railway
40
40
64
64
180
MP 195
MP 205
MP 215
MP 225
MP 235
Segment 64-1
Segment 64-2
Segment 64-3
SR 64 Corridor Segments
Segment 64 - 1: Junction of I-40 to Valle (MP 185 - 213)
Segment 64 - 2: Valle to Tusayan (MP 213 - 234)
Segment 64 - 3: Tusayan to Grand Canyon National Park (MP 234 - 237)
SR 64 Corridor Profile Study: I-40 to Grand Canyon National Park
Bridge Vertical Clearance
2016 Data
N
Miles
0 1 2 3 4
Corridor Segment
Interstate
U.S. Highway\State Route
Local Road
Rail
State Boundary
County Boundary
City Boundary
BRIDGE VERTICAL CLEARANCE
GOOD (>16.5)
FAIR (16.0-16.5)
POOR (<16.0)
NO UP

Appendix B: Performance Area Detailed Calculation Methodologies

Pavement Performance Area Calculation Methodologies

This section summarizes the approach for developing the primary and secondary performance measures in the Pavement performance area as shown in the following graphic:



This performance area is used to evaluate mainline pavement condition. Pavement condition data for ramps, frontage roads, crossroads, etc. was not included in the evaluation.

Primary Pavement Index

The Pavement Index is calculated based on the use of two pavement condition ratings from the ADOT Pavement Database. The two ratings are the International Roughness Index (IRI) and the Cracking rating. The calculation of the Pavement Index uses a combination of these two ratings.

The IRI is a measurement of the pavement roughness based on field-measured longitudinal roadway profiles. To facilitate the calculation of the index, the IRI rating was converted to a Pavement Serviceability Rating (PSR) using the following equation:

$$PSR = 5 * e^{-0.0038*IRI}$$

The Cracking Rating is a measurement of the amount of surface cracking based on a field-measured area of 1,000 square feet that serves as a sample for each mile. To facilitate the calculation of the index, the Cracking Rating was converted to a Pavement Distress Index (PDI) using the following equation:

$$PDI = 5 - (0.345 * C^{0.66})$$

Both the PSR and PDI use a 0 to 5 scale with 0 representing the lowest performance and 5 representing the highest performance. The performance thresholds for interstates and non-interstates shown in the tables below were used for the PSR and PDI.

Performance Level for Interstates	IRI (PSR)	Cracking (PDI)
Good	<75 (>3.75)	<7 (>3.75)
Fair	75 - 117 (3.20 - 3.75)	7 - 12 (3.22 - 3.75)
Poor	>117 (<3.20)	>12 (<3.22)

Performance Level for Non-Interstates	IRI (PSR)	Cracking (PDI)
Good	<94 (>3.5)	<9 (>3.5)
Fair	94 - 142 (2.9 - 3.5)	9 - 15 (2.9 - 3.5)
Poor	>142 (<2.9)	>15 (<2.9)

The PSR and PDI are calculated for each 1-mile section of roadway. If PSR or PDI falls into a poor rating (<3.2 for interstates, for example) for a 1-mile section, then the score for that 1-mile section is entirely (100%) based on the lower score (either PSR or PDI). If neither PSR or PDI fall into a poor rating for a 1-mile section, then the score for that 1-mile section is based on a combination of the lower rating (70% weight) and the higher rating (30% weight). The result is a score between 0 and 5 for each direction of travel of each mile of roadway based on a combination of both the PSR and the PDI.

The project corridor has been divided into segments. The Pavement Index for each segment is a weighted average of the directional ratings based on the number of travel lanes. Therefore, the condition of a section with more travel lanes will have a greater influence on the resulting segment Pavement Index than a section with fewer travel lanes.

Secondary Pavement Measures

Three secondary measures are evaluated:

- Directional Pavement Serviceability
- Pavement Failure
- Pavement Hot Spots

Directional Pavement Serviceability: Similar to the Pavement Index, the Directional Pavement Serviceability is calculated as a weighted average (based on number of lanes) for each segment. However, this rating only utilizes the PSR and is calculated separately for each direction of travel. The PSR uses a 0 to 5 scale with 0 representing the lowest performance and 5 representing the highest performance.

Pavement Failure: The percentage of pavement area rated above the failure thresholds for IRI or Cracking is calculated for each segment. In addition, the Standard score (z-score) is calculated for each segment.

The Standard score (z-score) is the number of standard deviations above or below the mean. Therefore, a Standard score between -0.5 and +0.5 is "average", less than -0.5 is lower (better) than average, and higher than +0.5 is above (worse) than average.

Pavement Hot Spots: The Pavement Index map identifies locations that have an IRI rating or Cracking rating that fall above the failure threshold as identified by ADOT Pavement Group. For interstates, an IRI rating above 105 or a Cracking rating above 15 will be used as the thresholds which are slightly different than the ratings shown previously. For non-interstates, an IRI rating above 142 or a Cracking rating above 15 will be used as the thresholds.

Scoring

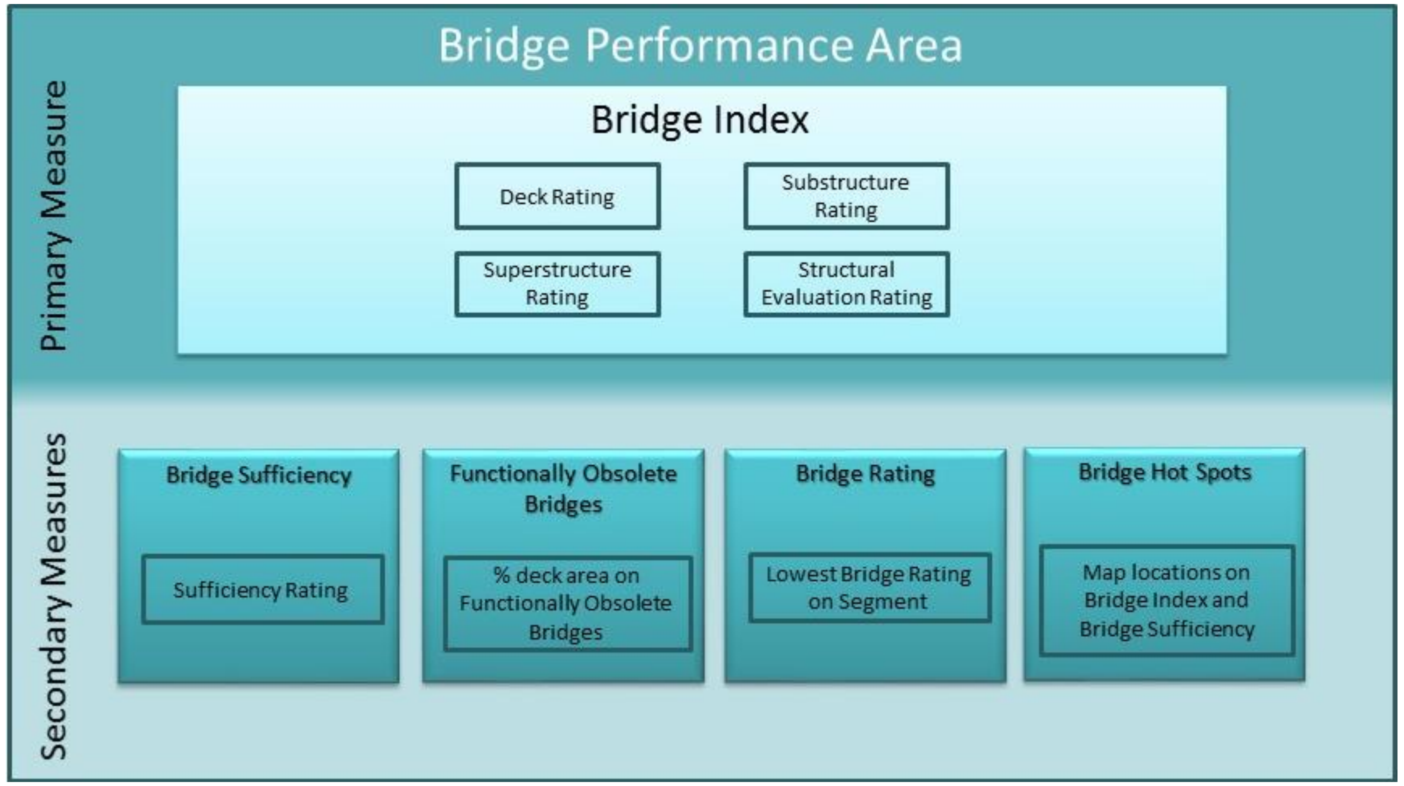
Performance Level	Pavement Index	
	Interstates	Non-Interstates
Good	>3.75	>3.5
Fair	3.2 - 3.75	2.9 - 3.5
Poor	<3.2	<2.9

Performance Level	Directional Pavement Serviceability	
	Interstates	Non-Interstates
Good	>3.75	>3.5
Fair	3.2 - 3.75	2.9 - 3.5
Poor	<3.2	<2.9

Performance Level	% Pavement Failure
Good	< 5%
Fair	5% – 20%
Poor	>20%

Bridge Performance Area Calculation Methodologies

This section summarizes the approach for developing the primary and secondary performance measures in the Bridge performance area as shown in the following graphic:



This performance area is used to evaluate mainline bridges. Bridges on ramps (that do not cross the mainline), frontage roads, etc. should not be included in the evaluation. Basically, any bridge that carries mainline traffic or carries traffic over the mainline should be included and bridges that do not carry mainline traffic, run parallel to the mainline (frontage roads), or do not cross the mainline should not be included.

Primary Bridge Index

The Bridge Index is calculated based on the use of four bridge condition ratings from the ADOT Bridge Database, also known as the Arizona Bridge Information and Storage System (ABISS). The four ratings are the Deck Rating, Substructure Rating, Superstructure Rating, and Structural Evaluation Rating. The calculation of the Bridge Index uses the lowest of these four ratings.

Each of the four condition ratings use a 0 to 9 scale with 0 representing the lowest performance and 9 representing the highest performance.

The project corridor has been divided into segments and the bridges are grouped together according to the segment definitions. In order to report the Bridge Index for each corridor segment, the Bridge Index for each segment is a weighted average based on the deck area for each bridge. Therefore, the condition of a larger bridge will have a greater influence on the resulting segment Bridge Index than a smaller bridge.

Secondary Bridge Measures

Four secondary measures will be evaluated:

- Bridge Sufficiency
- Functionally Obsolete Bridges
- Bridge Rating
- Bridge Hot Spots

Bridge Sufficiency: Similar to the Bridge Index, the Bridge Sufficiency rating is calculated as a weighted average (based on deck area) for each segment. The Bridge Sufficiency rating is a scale of 0 to 100 with 0 representing the lowest performance and 100 representing the highest performance. A rating of 80 or above represents “good” performance, a rating between 50 and 80 represents “fair” performance, and a rating below 50 represents “poor” performance.

Functionally Obsolete Bridges: The percentage of total deck area in a segment that is on functionally obsolete bridges is calculated for each segment. The deck area for each bridge within each segment that has been identified as functionally obsolete is totaled and divided by the total deck area for the segment to calculate the percentage of deck area on functionally obsolete bridges for each segment.

The thresholds for this performance measure are determined based on the Standard score (z-score). The Standard score (z-score) is the number of standard deviations above or below the mean. Therefore, a Standard score between -0.5 and +0.5 is “average”, less than -0.5 is lower (better) than average, and higher than +0.5 is above (worse) average.

Bridge Rating: The Bridge Rating simply identifies the lowest bridge rating on each segment. This performance measure is not an average and therefore is not weighted based on the deck area. The Bridge Index identifies the lowest rating for each bridge, as described above. Each of the four condition ratings use a 0 to 9 scale with 0 representing the lowest performance and 9 representing the highest performance.

Bridge Hot Spots: The Bridge Index map identifies individual bridge locations that are identified as hot spots. Hot spots are bridges that have a single rating of 4 in any of the four ratings, or multiple ratings of 5 in the deck, substructure or superstructure ratings.

Scoring:

Performance Level	Bridge Index
Good	>6.5
Fair	5.0-6.5
Poor	<5.0

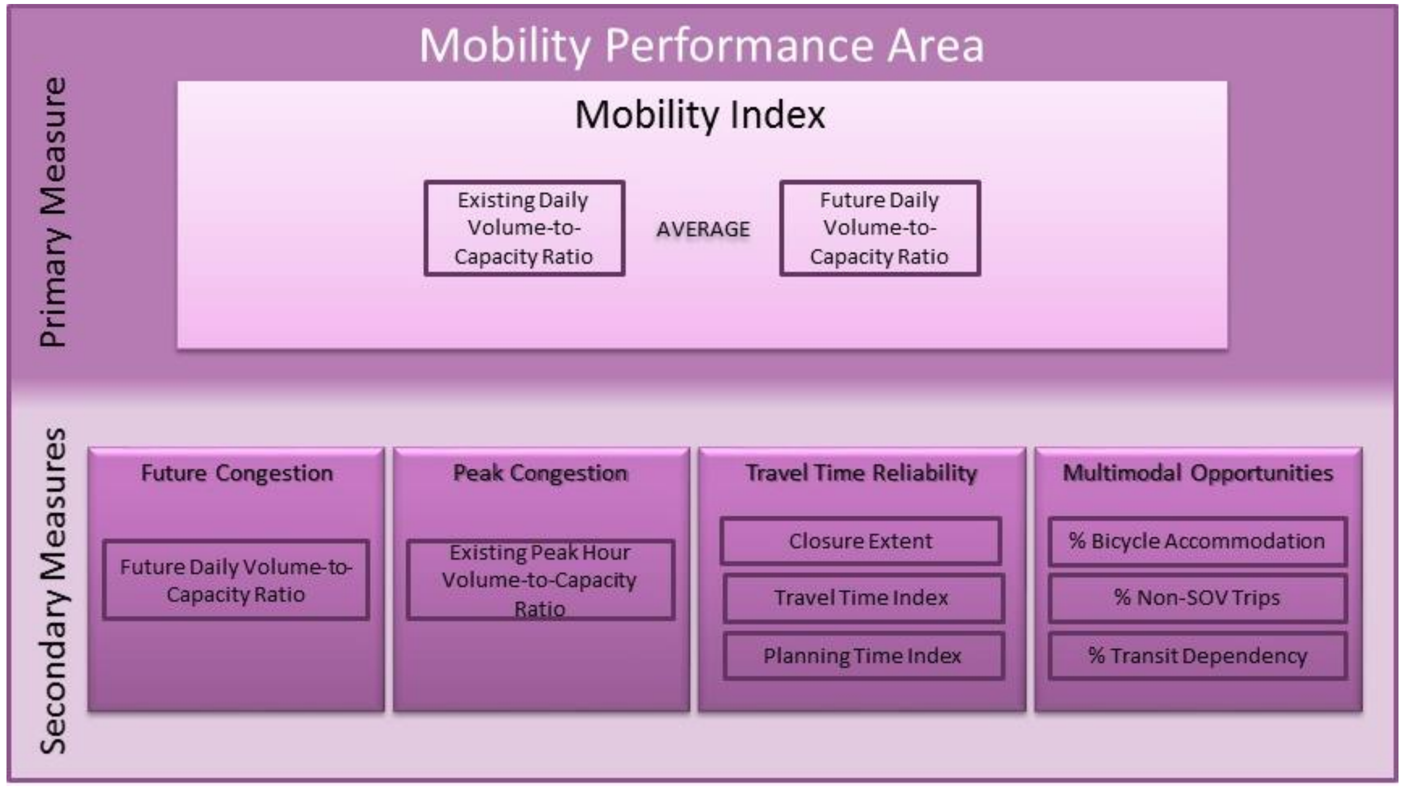
Performance Level	Sufficiency Rating
Good	>80
Fair	50-80
Poor	<50

Performance Level	Bridge Rating
Good	>6
Fair	5-6
Poor	<5

Performance Level	% Functionally Obsolete
Good	< 12%
Fair	12%-40%
Poor	>40%

Mobility Performance Area Calculation Methodologies

This section summarizes the approach for developing the primary and secondary performance measures in the Mobility performance area as shown in the following graphic:



Primary Mobility Index

The primary Mobility Index is an average of the existing daily volume-to-capacity (V/C) ratio and the future daily V/C ratio for each segment of the corridor.

Existing Daily V/C: The existing daily V/C ratio for each segment is calculated by dividing the 2014 Annual Average Daily Traffic (AADT) volume for each segment by the total Level of Service (LOS) E capacity volume for that segment

The capacity is calculated using the HERS Procedures for Estimating Highway Capacity[2]. The HERS procedure incorporates HCM 2010 methodologies. The methodology includes capacity estimation procedures for multiple facility types including freeways, rural two-lane highways, multilane highways, and signalized and non-signalized urban sections.

The segment capacity is defined as a function of the number of mainline lanes, shoulder width, interrupted or uninterrupted flow facilities, terrain type, percent of truck traffic, and the designated urban or rural environment.

The AADT for each segment is calculated by applying a weighted average across the length of the segment based on the individual 24-hour volumes and distances associated with each HPMS count station within each segment.

The following example equation is used to determine the weighted average of a segment with two HPMS count locations within the corridor

((HPMS 1 Distance x HPMS 1 Volume) + (HPMS 2 Distance x HPMS 2 Volume))/Total Segment Length

For specific details regarding the HERS methodology used, refer to the *Procedures for Estimating Highway Capacity, draft Technical Memorandum.*

Future Daily V/C: The future daily V/C ratio for each segment is calculated by dividing the 2035 AADT volume for each segment by the 2014 LOS E capacity. The capacity volume used in this calculation is the same as is utilized in the existing daily V/C equation.

The future AADT daily volumes are generated by applying an average annual compound growth rate (ACGR) to each 2014 AADT segment volume. The following equation is used to apply the average annual compound growth rate:

2035 AADT = 2014 AADT x ((1+ACGR)^(2035-2014))

The ACGR for each segment is defined by comparing the total volumes in the 2010 Arizona Travel Demand Model (AZTDM2) to the 2035 AZTDM2 traffic volumes at each existing HPMS count station location throughout the corridor. Each 2010 and 2035 segment volume is defined using the same weighted average equation described in the *Existing Daily V/C* section above and then summing the directional volumes for each location. The following equation is used to determine the ACGR for each segment:

ACGR = ((2035 Volume/2010 Volume)^(1/(2035-2010))))-1

Secondary Mobility Measures

Four secondary measures are evaluated:

- Future Congestion
- Peak Congestion
- Travel Time Reliability

[2] HERS Support – 2011, Task 6: Procedures for Estimating Highway Capacity, draft Technical Memorandum. Cambridge Systematics. Prepared for the Federal Highway Administration. March 2013.

- Closure Extent
  - Directional Travel Time Index
  - Directional Planning Time Index
- Multimodal Opportunities
  - % Bicycle Accommodation
  - % Non-Single Occupancy Vehicle (SOV) Trips
  - % Transit Dependency

Future Congestion: The future daily V/C ratios for each segment in the corridor that are calculated and used in the Mobility Index as part of the overall average between Existing Daily V/C and Future Daily V/C are applied independently as a secondary measure. The methods to calculate the Future Daily V/C can be referenced in the Mobility Index section.

Peak Congestion: Peak Congestion has been defined as the peak hour V/C ratio in both directions of the corridor. The peak hour V/C ratio is calculated using the HERS method as described previously. The peak hour volume utilizes the directional AADT for each segment, which is calculated by applying a weighted average across the length of the segment based on the individual directional 24-hour volumes and distances associated with each HPMS count station within each segment. The segment capacity is defined based on the characteristics of each segment including number of lanes, terrain type, and environment, similar to the 24-hour volumes using the HERS method.

Travel Time Reliability: Travel time reliability is a secondary measure that includes three indicators. The three indicators are the number of times a piece of a corridor is closed for any specific reason, the directional Travel Time Index (TTI), and the directional Planning Time Index (PTI).

Closure Extent: The number of times a roadway is closed is documented through the HCRS dataset. Closure Extent is defined as the average number of times a particular milepost of the corridor is closed per year per mile in a specific direction of travel. The weighted average of each occurrence takes into account the distance over which a specific occurrence spans.

Thresholds that determine levels of good, fair, and poor are based on the average number of closures per mile per year within each of the identified statewide significant corridors by ADOT. The thresholds shown at the end of this section represent statewide averages across those corridors.

Directional Travel Time and Planning Time Index: In terms of overall mobility, the TTI is the relationship of the mean peak period travel time in a specific section of the corridor to the free-flow travel time in the same location. The PTI is the relationship of the 95th percentile highest travel time to the free-flow travel time (based on the posted speed limit) in a specific section of the corridor. The TTI and PTI can be converted into speed-based indices by recognizing that speed is equal to distance traveled divided by travel time. The inverse relationship between travel time and speed means that the 95th percentile highest travel time corresponds to the 5th percentile lowest speed.

Using HERE data provided by ADOT, four time periods for each data point were collected throughout the day (AM peak, mid-day, PM peak, and off-peak). Using the mean speeds and 5th percentile lowest mean speeds collected over 2014 for these time periods for each data location, four TTI and PTI calculations were made using the following formulas:

TTI = Posted Speed Limit/Mean Peak Hour Speed

PTI = Posted Speed Limit/5th Percentile Lowest Speed

The highest value of the four time periods calculation is defined as the TTI for that data point. The average TTI is calculated within each segment based on the number of data points collected. The value of the average TTI across each entry is used as the TTI for each respective segment within the corridor.

Multimodal Opportunities: Three multimodal opportunity indicators reflect the characteristics of the corridor that promote alternate modes to a single occupancy vehicle (SOV) for trips along the corridor. The three indicators include the percent bicycle accommodation, non-SOV trips, and transit dependency along the corridor.

Percent Bicycle Accommodation: For this secondary performance evaluation, outside shoulder widths are evaluated considering the roadway's context and conditions. This requires use of the roadway data that includes right shoulder widths, shoulder surface types, and speed limits, all of which are available in the following ADOT geographic information system (GIS) data sets:

- Right Shoulder Widths
- Left Shoulder Widths (for undivided roadways)
- Shoulder Surface Type (Both Left/Right)
- Speed Limit

Additionally, each segment's average AADT, estimated earlier in the Mobility performance area methodology, is used for the criteria to determine if the existing shoulder width meets the effective width.

The criteria for screening if a shoulder segment meets the recommended width criteria are as followed:

(1) If AADT <= 1500 OR Speed Limit <= 25 miles per hour (mph):
The segment's general purpose lane can be shared with bicyclists (no effective shoulder width required)

(2) If AADT > 1500 AND Speed Limit between (25 - 50 mph) AND Pavement Surface is Paved:
Effective shoulder width required is 4 feet or greater

(3) If AADT > 1500 AND Speed Limit >= 50 mph and Pavement Surface is Paved:
Effective shoulder width required is 6 feet or greater

The summation of the length of the shoulder sections that meet the defined effective width criteria, based on criteria above, is divided by the segment's total length to estimate the percent of the segment that accommodates bicycles as illustrated at the end of this section. If shoulder data is not available or appears erroneous, field measurements can substitute for the shoulder data.

<u>Percent Non-SOV Trips</u>: The percentage of non-SOV trips over distances less than 50 miles gives an indication of travel patterns along a section of the corridor that could benefit from additional multimodal options in the future.

Thresholds that determine levels of good, fair, and poor are based on the percent non-SOV trips within each of the identified statewide significant corridors by ADOT. The thresholds shown at the end of this section represent statewide averages across those corridors.

<u>Percent Transit Dependency</u>: 2008-2012 U.S. Census American Community Survey tract and state level geographic data and attributes from the tables B08201 (Number of Vehicles Available by Household Size) and B17001 (Population in Poverty within the Last 12 Months) were downloaded with margins of error included from the Census data retrieval application Data Ferret. Population ranges for each tract were determined by adding and subtracting the margin of error to each estimate in excel. The tract level attribute data was then joined to geographic tract data in GIS. Only tracts within a one mile buffer of each corridor are considered for this evaluation.

Tracts that have a statistically significantly larger number of either people in poverty or households with only one or no vehicles available than the state average are considered potentially transit dependent.

Example: The state average for zero or one vehicles households (HHs) is between 44.1% and 45.0%. Tracts which have the lower bound of their range above the upper bound of the state range have a greater percentage of zero/one vehicle HHs than the state average. Tracts that have their upper bound beneath the lower bound of the state range have a lesser percentage of zero/one vehicles HHs than the state average. All other tracts that have one of their bounds overlapping with the state average cannot be considered statistically significantly different because there is a chance the value is actually the same.

In addition to transit dependency, the following attributes are added to the Multimodal Opportunities map based on available data.

- Shoulder width throughout the corridor based on 'Shoulder Width' GIS dataset provided by ADOT
- Intercity bus routes
- Multiuse paths within the corridor right-of-way, if applicable

<u>Scoring:</u>

Volume-to-Capacity Ratios		
Urban and Fringe Urban		
Good - LOS A-C	V/C ≤ 0.71	*Note - ADOT Roadway Design Standards indicate Urban and Fringe Urban roadways should be designed to level of service C or better
Fair - LOS D	V/C > 0.71 & ≤ 0.89	
Poor - LOS E or less	V/C > 0.89	
Rural		
Good - LOS A-B	V/C ≤ 0.56	*Note - ADOT Roadway Design Standards indicate Rural roadways should be designed to level of service B or better
Fair - LOS C	V/C > 0.56 & ≤ 0.76	
Poor - LOS D or less	V/C > 0.76	

Performance Level	Closure Extent
Good	≤ 0.22
Fair	> 0.22 & ≤ 0.62
Poor	V/C > 0.62

Performance Level	TTI on Uninterrupted Flow Facilities
Good	< 1.15
Fair	≥ 1.15 & < 1.33
Poor	≥ 1.33

Performance Level	TTI on Interrupted Flow Facilities
Good	< 1.30
Fair	≥ 1.30 & < 1.2.00
Poor	≥ 2.00

Performance Level	PTI on Uninterrupted Flow Facilities
Good	< 1.30
Fair	≥ 1.30 & < 1.50
Poor	≥ 1.50

Performance Level	PTI Interrupted Flow Facilities
Good	< 3.00
Fair	≥ 3.00 & < 6.00
Poor	≥ 6.00

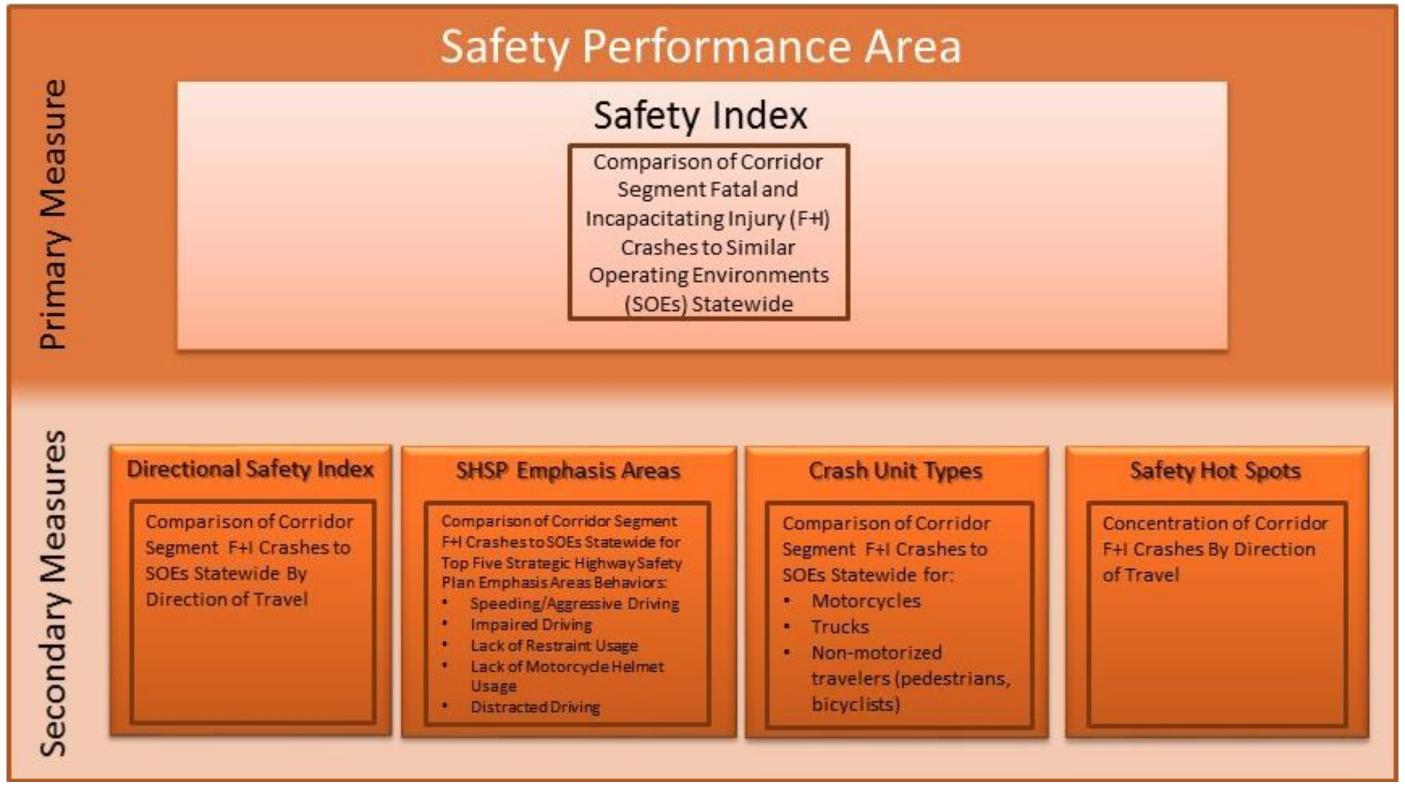
Performance Level	Percent Bicycle Accommodation
Good	≥ 90%
Fair	> 60% & ≤ 90%
Poor	< 60%

Performance Level	Percent Non-SOV Trips
Good	≥ 17%
Fair	> 11% & ≤ 17%
Poor	< 11%

Performance Level	Percent Transit Dependency
Good	Tracts with both zero and one vehicle household population in poverty percentages below the statewide average
Fair	Tracts with either zero and one vehicle household or population in poverty percentages below the statewide average
Poor	Tracts with both zero and one vehicle household and population in poverty percentages above the statewide average

Safety Performance Area Calculation Methodologies

This section summarizes the approach for developing the primary and secondary performance measures in the Safety performance area as shown in the following graphic:



Primary Safety Index

The Safety Index is a safety performance measure based on the bi-directional (i.e., both directions combined) frequency and rate of fatal and incapacitating injury crashes, the relative cost of those types of crashes, and crash occurrences on similar roadways in Arizona. According to ADOT's 2010 Highway Safety Improvement Program Manual, fatal crashes have an estimated cost that is 14.5 times the estimated cost of incapacitating injury crashes ($5.8 million compared to $400,000).

The Combined Safety Score (CSS) is an interim measure that combines fatal and incapacitating injury crashes into a single value. The CSS is calculated using the following generalized formula:

*CSS = 14.5 * (Normalized Fatal Crash Rate + Frequency) + (Normalized Incapacitating Injury Crash Rate + Frequency)*

Because crashes vary depending on the operating environment of a particular roadway, statewide CSS values were developed for similar operating environments defined by functional classification, urban vs. rural setting, number of travel lanes, and traffic volumes. To determine the Safety Index of a particular segment, the segment CSS is compared to the average statewide CSS for the similar statewide operating environment.

The Safety Index is calculated using the following formula:

Safety Index = Segment CSS / Statewide Similar Operating Environment CSS

The average annual Safety Index for a segment is compared to the statewide similar operating environment annual average, with one standard deviation from the statewide average forming the scale break points.

The more a particular segment's Safety Index value is below the statewide similar operating environment average, the better the safety performance is for that particular segment as a lower value represents fewer crashes.

Scoring:

The scale for rating the Safety Index depends on the operating environments selected, as shown in the table below.

Similar Operating Environment	Safety Index (Overall & Directional)	
	Lower Limit of Average*	Upper Limit of Average*
2 or 3 Lane Undivided Highway	0.94	1.06
2 or 3 or 4 Lane Divided Highway	0.77	1.23
4 or 5 Lane Undivided Highway	0.80	1.20
6 Lane Highway	0.56	1.44
Rural 4 Lane Freeway with Daily Volume < 25,000	0.73	1.27
Rural 4 Lane Freeway with Daily Volume > 25,000	0.68	1.32
Urban 4 Lane Freeway	0.79	1.21
Urban or Rural 6 Lane Freeway	0.82	1.18
Urban > 6 Lane Freeway	0.80	1.20

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

Some corridor segments may have a very low number of total fatal and incapacitating injury crashes. Low crash frequencies (i.e., a small sample size) can translate into performance ratings that can be unstable. In some cases, a change in crash frequency of one crash (one additional crash or one less crash) could result in a change in segment performance of two levels. To avoid reliance on performance ratings where small changes in crash frequency result in large changes in performance, the following two criteria were developed to identify segments with "insufficient data" for assessing performance for the Safety Index. Both of these criteria must be met for a segment to have "insufficient data" to reliably rate the Safety Index performance:

- If the crash sample size (total fatal plus incapacitating injury crashes) for a given segment is less than five crashes over the five-year analysis period; AND

- If a change in one crash results in a change in segment performance by two levels (i.e., a change from below average to above average performance or a change from above average to below average frequency), the segment has "insufficient data" and Safety Index performance ratings are unreliable.

Secondary Safety Measures

The Safety performance area has four secondary measures related to fatal and incapacitating injury crashes:

- Directional Safety Index
- Strategic Highway Safety Plan (SHSP) Behavior Emphasis Areas
- Crash Unit Types
- Safety Hot Spots

Directional Safety Index: The Direction Safety Index shares the same calculation procedure and thresholds as the Safety Index. However, the measure is based on the directional frequency and rate of fatal and incapacitating injury crashes.

Similar to the Safety Index, the segment CSS is compared to the average statewide CSS for the similar statewide operating environment. The Directional Safety Index follows the lead of the Safety Index in terms of "insufficient data" status. If the Safety Index meets both criteria for "insufficient data", the Directional Safety Index should also be changed to "insufficient data". If the Safety Index does not meet both criteria for "insufficient data", the Directional Safety Index would also not change to say "insufficient data"

SHSP Behavior Emphasis Areas: ADOT's 2014 SHSP identifies several emphasis areas for reducing fatal and incapacitating injury crashes. The top five SHSP emphasis areas relate to the following driver behaviors:

- Speeding and aggressive driving
- Impaired driving
- Lack of restraint usage
- Lack of motorcycle helmet usage
- Distracted driving

To develop a performance measure that reflects these five emphasis areas, the percentage of total fatal and incapacitating injury crashes that involves at least one of the emphasis area driver behaviors on a particular segment is compared to the statewide average percentage of crashes involving at least one of the emphasis area driver behaviors on roads with similar operating environments in a process similar to how the Safety Index is developed.

To increase the crash sample size for this performance measure, the five behavior emphasis areas are combined to identify fatal and incapacitating injury crashes that exhibit one or more of the behavior emphasis areas.

The SHSP behavior emphasis areas performance is calculated using the following formula:

% Crashes Involving SHSP Behavior Emphasis Areas = Segment Crashes Involving SHSP Behavior Emphasis Areas / Total Segment Crashes

The percentage of total crashes involving SHSP behavior emphasis areas for a segment is compared to the statewide percentages on roads with similar operating environments. One standard deviation from the statewide average percentage forms the scale break points.

When assessing the performance of the SHSP behavior emphasis areas, the more the frequency of crashes involving SHSP behavior emphasis areas is below the statewide average implies better levels of segment performance. Thus, lower values are better, similar to the Safety Index.

Scoring:

The scale for rating the SHSP behavior emphasis areas performance depends on the crash history on similar statewide operating environments, as shown in the table below:

Similar Operating Environment	Crashes in SHSP Top 5 Emphasis Areas	
	Lower Limit of Average*	**Upper Limit of Average***
2 or 3 Lane Undivided Highway	51.2%	57.5%
2 or 3 or 4 Lane Divided Highway	44.4%	54.4%
4 or 5 Lane Undivided Highway	42.4%	51.1%
6 Lane Highway	35.3%	46.5%
Rural 4 Lane Freeway with Daily Volume < 25,000	42.8%	52.9%
Rural 4 Lane Freeway with Daily Volume > 25,000	40.8%	57.1%
Urban 4 Lane Freeway	49.1%	59.4%
Urban or Rural 6 Lane Freeway	33.5%	57.2%
Urban > 6 Lane Freeway	42.6%	54.8%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

The SHSP behavior emphasis areas secondary safety performance measure for the Safety performance area includes proportions of specific types of crashes within the total fatal and incapacitating injury crash frequencies. This more detailed categorization of fatal and incapacitating injury crashes can result in low crash frequencies (i.e., a small sample size) that translate into performance ratings that can be unstable. In some cases, a change in crash frequency of one crash (one additional crash or one less crash) could result in a change in segment performance of two levels. To avoid reliance on performance ratings where small changes in crash frequency result in large changes in performance, the following criteria were developed to identify segments with "insufficient data" for assessing performance for the SHSP behavior emphasis areas secondary safety performance measure. If any of these criteria are met for a segment, that segment has "insufficient data" to reliably rate the SHSP behavior emphasis areas performance:

- If the crash sample size (total fatal plus incapacitating injury crashes) for a given segment is less than five crashes over the five-year analysis period, the segment has "insufficient data" and performance ratings are unreliable. OR
- If a change in one crash results in a change in segment performance by two levels (i.e., a change from below average to above average performance or a change from above average to below average frequency), the segment has "insufficient data" and performance ratings are unreliable. OR
- If the corridor average segment crash frequency for the SHSP behavior emphasis areas performance measure is less than two crashes over the five-year analysis period, the entire SHSP behavior emphasis areas performance measure has "insufficient data" and performance ratings are unreliable.

Crash Unit Type Emphasis Areas: ADOT's SHSP also identifies emphasis areas that relate to the following "unit-involved" crashes:

- Heavy vehicle (trucks)-involved crashes
- Motorcycle-involved crashes
- Non-motorized traveler (pedestrians and bicyclists)-involved crashes

To develop a performance measure that reflects the aforementioned crash unit type emphasis areas, the percentage of total fatal and incapacitating injury crashes that involves a given crash unit type emphasis area on a particular segment is compared to the statewide average percentage of crashes involving that same crash unit type emphasis area on roads with similar operating environments in a process similar to how the Safety Index is developed.

The SHSP crash unit type emphasis areas performance is calculated using the following formula:

% Crashes Involving Crash Unit Type = Segment Crashes Involving Crash Unit Type / Total Segment Crashes

The percentage of total crashes involving crash unit types for a segment is compared to the statewide percentages on roads with similar operating environments. One standard deviation from the statewide average percentage forms the scale break points.

When assessing the performance of the crash unit types, the more the frequency of crashes involving crash unit types is below the statewide average implies better levels of segment performance. Thus, lower values are better, similar to the Safety Index. The scale for rating the unit-involved crash performance depends on the crash history on similar statewide operating environments, as shown in the following tables.

Scoring:

Similar Operating Environment	Crashes Involving Trucks	
	Lower Limit of Average*	**Upper Limit of Average***
2 or 3 Lane Undivided Highway	5.2%	7.1%
2 or 3 or 4 Lane Divided Highway	3.5%	7.3%
4 or 5 Lane Undivided Highway	6.1%	9.6%
6 Lane Highway	0.3%	8.7%
Rural 4 Lane Freeway with Daily Volume < 25,000	13.2%	17.0%
Rural 4 Lane Freeway with Daily Volume > 25,000	7.2%	12.9%
Urban 4 Lane Freeway	6.8%	10.9%
Urban or Rural 6 Lane Freeway	6.2%	11.0%
Urban > 6 Lane Freeway	2.5%	6.0%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

Similar Operating Environment	Crashes Involving Motorcycles	
	Lower Limit of Average*	**Upper Limit of Average***
2 or 3 Lane Undivided Highway	18.5%	26.5%
2 or 3 or 4 Lane Divided Highway	16.3%	26.3%
4 or 5 Lane Undivided Highway	6.4%	9.4%
6 Lane Highway	0.0%	20.0%
Rural 4 Lane Freeway with Daily Volume < 25,000	5.0%	8.5%
Rural 4 Lane Freeway with Daily Volume > 25,000	7.7%	17.1%
Urban 4 Lane Freeway	9.3%	11.5%
Urban or Rural 6 Lane Freeway	6.7%	12.9%
Urban > 6 Lane Freeway	12.6%	20.5%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

Similar Operating Environment	Crashes Involving Non-Motorized Travelers	
	Lower Limit of Average*	Upper Limit of Average*
2 or 3 Lane Undivided Highway	2.2%	4.2%
2 or 3 or 4 Lane Divided Highway	2.4%	4.5%
4 or 5 Lane Undivided Highway	4.7%	7.9%
6 Lane Highway	8.4%	17.4%
Rural 4 Lane Freeway with Daily Volume < 25,000	1.7%	2.5%
Rural 4 Lane Freeway with Daily Volume > 25,000	0.0%	0.0%
Urban 4 Lane Freeway	4.8%	10.3%
Urban or Rural 6 Lane Freeway	0.9%	6.7%
Urban > 6 Lane Freeway	0.5%	1.5%

** Lower/upper limit of Average calculated as one standard deviation below/above the Mean*

The crash unit types have the same "insufficient data" criteria as the SHSP behavior emphasis areas.

Safety Hot Spots: A hot spot analysis was conducted that identified abnormally high concentrations of fatal and incapacitating injury crashes along the study corridor by direction of travel. The identification of crash concentrations involves a GIS-based function known as "kernel density analysis". This measure is mapped for graphical display purposes with the Directional Safety Index but is not included in the Safety performance area rating calculations.

Freight Performance Area Calculation Methodologies

This section summarizes the approach for developing the primary and secondary performance measures in the Freight performance area as shown in the following graphic:

Primary Freight Index

The Freight Index is a reliability performance measure based on the planning time index for truck travel. The industry standard definition for the Truck Planning Time Index (TPTI) is the ratio of total travel time needed for 95% on-time arrival to free-flow travel time. The TPTI reflects the extra buffer time needed for on-time delivery while accounting for non-recurring delay. Non-recurring delay refers to unexpected or abnormal delay due to closures or restrictions resulting from circumstances such as crashes, inclement weather, and construction activities.

The TPTI can be converted into a speed-based index by recognizing that speed is equal to distance traveled divided by travel time. The inverse relationship between travel time and speed means that the 95th percentile highest travel time corresponds to the 5th percentile lowest speed. The speed-based TPTI is calculated using the following formula:

TPTI = Free-Flow Truck Speed / Observed 5th Percentile Lowest Truck Speed

Observed 5th percentile lowest truck speeds are available in the 2014 American Digital Cartography, Inc. HERE (formerly NAVTEQ) database to which ADOT has access. The free-flow truck speed is assumed to be 65 miles per hour or the posted speed, whichever is less. This upper limit of 65 mph accounts for governors that trucks often have that restrict truck speeds to no more than 65 mph, even when the speed limit may be higher.

For each corridor segment, the TPTI is calculated for each direction of travel and then averaged to create a bi-directional TPTI. When assessing performance using TPTI, the higher the TPTI value is above 1.0, the more buffer time is needed to ensure on-time delivery.

The Freight Index is calculated using the following formula to invert the overall TPTI:

Freight Index = 1 / Bi-directional TPTI

Inversion of the TPTI allows the Freight Index to have a scale where the higher the value, the better the performance, which is similar to the directionality of the scales of most of the other primary measures. This Freight Index scale is based on inverted versions of TPTI scales created previously by ADOT. The scale for rating the Freight Index differs between uninterrupted and interrupted flow facilities.

Secondary Freight Measures

The Freight performance area includes five secondary measures that provide an in-depth evaluation of the different characteristics of freight performance:

- Recurring Delay (Directional TTTI)
- Non-Recurring Delay (Directional TPTI)
- Closure Duration
- Bridge Vertical Clearance
- Bridge Vertical Clearance Hot Spots

Recurring Delay (Directional TTTI): The performance measure for recurring delay is the Directional Truck Travel Time Index (TTTI). The industry standard definition for TTTI is the ratio of average peak period travel time to free-flow travel time. The TTTI reflects the extra time spent in traffic during peak times due to recurring delay. Recurring delay refers to expected or normal delay due to roadway capacity constraints or traffic control devices.

Similar to the TPTI, the TTTI can be converted into a speed-based index by recognizing that speed is equal to distance traveled divided by travel time. The speed-based TTTI can be calculated using the following formula:

TTTI = Free-Flow Truck Speed / Observed Average Peak Period Truck Speed

Observed average peak period truck speeds are available in the 2014 American Digital Cartography, Inc. HERE (formerly NAVTEQ) database to which ADOT has access. The free-flow truck speed is assumed to be 65 mph or the posted speed, whichever is less.

For each corridor segment, the TTTI is calculated for each direction of travel. With the TTTI, the higher the TTTI value is above 1.0, the more time is spent in traffic during peak times. TTTI values are generally lower than TPTI values. The Directional TTTI scale is based on TTTI scales created previously by ADOT.

Non-Recurring Delay (Directional TPTI): The performance measure for non-recurring delay is the Directional TPTI. Directional TPTI is calculated as described previously as an interim step in the development of the Freight Index.

For each corridor segment, the TPTI is calculated for each direction of travel. With the TPTI, the higher the TPTI value is above 1.0, the more buffer time is needed to ensure on-time delivery.

Closure Duration: This performance measure related to road closures is average roadway closure (i.e., full lane closure) duration time in minutes. There are three main components to full closures that affect reliability – frequency, duration, and extent. In the freight industry, closure duration is the most important component because trucks want to minimize travel time and delay.

Data on the frequency, duration, and extent of full roadway closures on the ADOT State Highway System is available for 2010-2014 in the HCRS database that is managed and updated by ADOT.

The average closure duration in a segment – in terms of the average time a milepost is closed per mile per year on a given segment – is calculated using the following formula:

*Closure Duration = Sum of Segment (Closure Clearance Time * Closure Extent) / Segment Length*

The segment closure duration time in minutes can then be compared to statewide averages for closure duration in minutes, with one-half standard deviation from the average forming the scale break points. The scale for rating closure duration in minutes is found at the end of this section.

Bridge Vertical Clearance: This performance measure uses the vertical clearance information from the ADOT Bridge Database to identify locations with low vertical clearance. The minimum vertical clearance for all underpass structures (i.e., structures under which mainline traffic passes) is determined for each segment.

Bridge Vertical Clearance Hot Spots: This performance measure related to truck restrictions is the locations, or hot spots, where bridge vertical clearance issues restrict truck travel. Sixteen feet three inches (16.25') is the minimum standard vertical clearance value for state highway bridges over travel lanes.

Locations with lower vertical clearance values than the minimum standard are categorized by the ADOT Intermodal Transportation Department Engineering Permits Section as either locations where ramps exist that allow the restriction to be avoided or locations where ramps do not exist and the restriction cannot be avoided. The locations with vertical clearances below the minimum standard that cannot be ramped around are considered hot spots. This measure is mapped for graphical display purposes with the bridge vertical clearance map but is not included in the Freight performance area rating calculations.

<u>Scoring:</u>

Performance Level	Freight Index	
	Uninterrupted Flow Facilities	Interrupted Flow Facilities
Good	> 0.77	> 0.33
Fair	0.67 – 0.77	0.17 – 0.33
Poor	< 0.67	< 0.17

Performance Level	TTTI	
	Uninterrupted Flow Facilities	Interrupted Flow Facilities
Good	< 1.15	< 1.30
Fair	1.15 – 1.33	1.30 – 2.00
Poor	> 1.33	> 2.00

Performance Level	TPTI	
	Uninterrupted Flow Facilities	Interrupted Flow Facilities
Good	< 1.30	< 3.00
Fair	1.30 – 1.50	3.00 – 6.00
Poor	> 1.50	> 6.00

Performance Level	Closure Duration (minutes)
Good	< 44.18
Fair	44.18 – 124.86
Poor	> 124.86

Performance Level	Bridge Vertical Clearance
Good	> 16.5'
Fair	16.0' – 16.5'
Poor	< 16.0'

Appendix C: Performance Area Data

Pavement Performance Area Data

				EB			WB			EB		WB		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	EB	WB		EB	WB
Segment 1		*Interstate?*		No														
Milepost	185	to	186	2	120.84	15.00		-	-	3.16	2.9	-	-	3.01	#VALUE!		0	0
Milepost	186	to	187	2	120.84	15.00		-	-	3.16	2.9	-	-	3.01	#VALUE!		0	0
Milepost	187	to	188	2	122.43	6.00		-	-	3.14	3.9	-	-	3.36	#VALUE!		0	0
Milepost	188	to	189	4	91.07	25.00		-	-	3.54	2.1	-	-	2.11	#VALUE!		4	0
Milepost	189	to	190	2	94.65	4.00		-	-	3.49	4.1	-	-	3.68	#VALUE!		0	0
Milepost	190	to	191	2	119.32	8.00		-	-	3.18	3.6	-	-	3.32	#VALUE!		0	0
Milepost	191	to	192	2	114.18	6.00		-	-	3.24	3.9	-	-	3.43	#VALUE!		0	0
Milepost	192	to	193	2	99.77	12.00		-	-	3.42	3.2	-	-	3.28	#VALUE!		0	0
Milepost	193	to	194	2	105.28	3.00		-	-	3.35	4.3	-	-	3.63	#VALUE!		0	0
Milepost	194	to	195	2	97.19	8.00		-	-	3.46	3.6	-	-	3.51	#VALUE!		0	0
Milepost	195	to	196	2	120.14	4.00		-	-	3.17	4.1	-	-	3.46	#VALUE!		0	0
Milepost	196	to	197	2	134.76	12.00		-	-	3.00	3.2	-	-	3.06	#VALUE!		0	0
Milepost	197	to	198	2	99.13	10.00		-	-	3.43	3.4	-	-	3.43	#VALUE!		0	0
Milepost	198	to	199	2	145.87	9.00		-	-	2.87	3.5	-	-	2.87	#VALUE!		2	0
Milepost	199	to	200	2	109.80	30.00		-	-	3.29	1.7	-	-	1.74	#VALUE!		2	0
Milepost	200	to	201	2	106.97	10.00		-	-	3.33	3.4	-	-	3.36	#VALUE!		0	0
Milepost	201	to	202	2	113.38	9.00		-	-	3.25	3.5	-	-	3.33	#VALUE!		0	0
Milepost	202	to	203	2	120.17	5.00		-	-	3.17	4.0	-	-	3.42	#VALUE!		0	0
Milepost	203	to	204	2	129.75	8.00		-	-	3.05	3.6	-	-	3.23	#VALUE!		0	0
Milepost	204	to	205	2	132.83	9.00		-	-	3.02	3.5	-	-	3.17	#VALUE!		0	0
Milepost	205	to	206	2	223.83	7.00		-	-	2.14	3.8	-	-	2.14	#VALUE!		2	0
Milepost	206	to	207	2	223.23	12.00		-	-	2.14	3.2	-	-	2.14	#VALUE!		2	0
Milepost	207	to	208	2	172.21	20.00		-	-	2.60	2.5	-	-	2.51	#VALUE!		2	0
Milepost	208	to	209	2	129.48	20.00		-	-	3.06	2.5	-	-	2.51	#VALUE!		2	0
Milepost	209	to	210	2	142.93	8.00		-	-	2.90	3.6	-	-	3.12	#VALUE!		2	0
Milepost	210	to	211	2	173.98	30.00		-	-	2.58	1.7	-	-	1.74	#VALUE!		2	0
Milepost	211	to	212	2	184.75	55.00		-	-	2.48	0.1	-	-	0.14	#VALUE!		2	0
Milepost	212	to	213	2	102.89	5.00		-	-	3.38	4.0	-	-	3.57	#VALUE!		0	0
			Total	58			0											22
			Weighted Average							3.09	3.19	#VALUE!	#VALUE!	2.88	#VALUE!			
			Factor							1.00		1.00						
			Indicator Score							**3.09**		**#VALUE!**						**37.9%**
			Pavement Index													**2.88**		

				EB			WB			EB		WB		Composite		Pavement Index	% Pavement Failure	
				# of Lanes	IRI	Cracking	# of Lanes	IRI	Cracking	PSR	PDI	PSR	PDI	EB	WB		EB	WB
Segment 2		*Interstate?*		No														
Milepost	213	to	214	2	133.00	8.00		-	-	3.02	3.6	-	-	3.20	#VALUE!		0	0
Milepost	214	to	215	2	74.55	1.00		-	-	3.77	4.7	-	-	4.03	#VALUE!		0	0
Milepost	215	to	216	2	67.86	9.00		-	-	3.86	3.5	-	-	3.63	#VALUE!		0	0
Milepost	216	to	217	2	72.32	7.00		-	-	3.80	3.8	-	-	3.77	#VALUE!		0	0
Milepost	217	to	218	2	88.49	5.00		-	-	3.57	4.0	-	-	3.70	#VALUE!		0	0
Milepost	218	to	219	2	107.56	5.00		-	-	3.32	4.0	-	-	3.53	#VALUE!		0	0
Milepost	219	to	220	2	104.26	8.00		-	-	3.36	3.6	-	-	3.45	#VALUE!		0	0
Milepost	220	to	221	2	101.04	4.00		-	-	3.41	4.1	-	-	3.63	#VALUE!		0	0
Milepost	221	to	222	2	81.58	6.00		-	-	3.67	3.9	-	-	3.73	#VALUE!		0	0
Milepost	222	to	223	2	98.83	7.00		-	-	3.43	3.8	-	-	3.53	#VALUE!		0	0
Milepost	223	to	224	2	103.21	6.00		-	-	3.38	3.9	-	-	3.53	#VALUE!		0	0
Milepost	224	to	225	2	112.97	6.00		-	-	3.25	3.9	-	-	3.44	#VALUE!		0	0
Milepost	225	to	226	2	109.96	7.00		-	-	3.29	3.8	-	-	3.43	#VALUE!		0	0
Milepost	226	to	227	2	102.95	8.00		-	-	3.38	3.6	-	-	3.46	#VALUE!		0	0
Milepost	227	to	228	2	96.56	3.00		-	-	3.46	4.3	-	-	3.71	#VALUE!		0	0
Milepost	228	to	229	2	104.30	8.00		-	-	3.36	3.6	-	-	3.45	#VALUE!		0	0
Milepost	229	to	230	2	86.05	6.00		-	-	3.61	3.9	-	-	3.69	#VALUE!		0	0
Milepost	230	to	231	2	78.76	4.00		-	-	3.71	4.1	-	-	3.84	#VALUE!		0	0
Milepost	231	to	232	2	98.96	3.00		-	-	3.43	4.3	-	-	3.69	#VALUE!		0	0
Milepost	232	to	233	2	78.47	12.00		-	-	3.71	3.2	-	-	3.37	#VALUE!		0	0
Milepost	233	to	234	2	83.73	3.00		-	-	3.64	4.3	-	-	3.83	#VALUE!		0	0
			Total	42			0											0
			Weighted Average							3.50	3.90	#VALUE!	#VALUE!	3.60	#VALUE!			
			Factor							1.00		1.00						
			Indicator Score							**3.50**		**#VALUE!**						**0.0%**
			Pavement Index													**3.60**		
Segment 3		*Interstate?*		No														
Milepost	234	to	235	2	78.42	9.00		-	-	3.71	3.5	-	-	3.58	#VALUE!		0	0
Milepost	235	to	236	2	107.50	5.00		-	-	3.32	4.0	-	-	3.53	#VALUE!		0	0
Milepost	236	to	237	2	92.93	0.00		-	-	3.51	5.0	-	-	3.96	#VALUE!		0	0
			Total	6			0											0
			Weighted Average							3.52	4.18	#VALUE!	#VALUE!	3.69	#VALUE!			
			Factor							1.00		1.00						
			Indicator Score							**3.52**		**#VALUE!**						**0.0%**
			Pavement Index													**3.69**		

Bridge Performance Area Data

Structure Name (A209)	Structure # (N8)	Milepost (A232)	Area (A225)	Bridge Sufficiency: Sufficiency Rating	Bridge Index: Deck (N58)	Bridge Index: Sub (N59)	Bridge Index: Super (N60)	Bridge Index: Eval (N67)	Bridge Index: Lowest	Functionally Obsolete Bridges: Deck Area on Func Obsolete	Bridge Rating	Hot Spots on Bridge Index map
Segment 1												
Cataract Canyon Bridge	2735	187.33	4961	84.60	7.00	7.00	7.00	7.00	7.0	0		
Total			4,961									
Weighted Average				84.60					7.00	0.00%		
Factor				1.00					1.00	1.00		
Indicator Score				**84.60**						**0.00%**	**7**	
Bridge Index									**7.00**			
Segment 2												
#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A		
Total			#N/A									
Weighted Average				#N/A					#N/A	#N/A		
Factor				1.00					1.00	1.00		
Indicator Score				**#N/A**						**#N/A**	**#N/A**	
Bridge Index									**#N/A**			
Segment 3												
#N/A		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A		
Total			#N/A									
Weighted Average				#N/A					#N/A	#N/A		
Factor				1.00					1.00	1.00		
Indicator Score				**#N/A**						**#N/A**	**#N/A**	
Bridge Index									**#N/A**			

Mobility Performance Area Data

Segment	Begin MP	End MP	Length (mi)	Facility Type	Flow Type	Terrain	No. of Lanes	Capacity Environment Type	Lane Width (feet)	Weighted Average Posted Speed Limit (mph)	Divided or Undivided	Access Points (per mile)	% No-Passing Zone	Street Parking
64-1	185	213	28	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	65	Undivided	2.4	40%	N/A
64-2	213	234	21	Rural	Uninterrupted	Level	2	Rural Two-Lane, Non-Signalized	12.00	64	Undivided	2.0	41%	N/A
64-3	234	237	3	Rural	Interrupted	Level	2	Urban/Rural Single or Multilane Signalized	12.00	44	Undivided	10.0	16%	N/A

Car TTI and PTI/Truck TTTI and TPTI – Northbound/Eastbound

Segment	TMC	timeperiod	week type	road number	road direction	cars mean	trucks mean	cars P05	trucks P05	Posted Speed limit	Assumed car free-flow speed	Assumed truck free-flow speed	cars TTI	Trucks TTI	cars PTI	Trucks PTI	Cars PeakTTI	Trucks PeakTTI	Cars PeakPTI	Trucks PeakPTI
87-1	115P04411	1 AM Peak	Weekday	AZ-87	Northbound	35.6	33.9	8.7	12.4	45	45	45	1.26	1.33	5.17	3.63	1.26	1.42	8.04	6.58
87-1	115P04411	2 Mid Day	Weekday	AZ-87	Northbound	36.6	34.0	5.6	9.9	45	45	45	1.23	1.32	8.04	4.53				
87-1	115P04411	3 PM Peak	Weekday	AZ-87	Northbound	35.9	31.6	5.6	6.8	45	45	45	1.25	1.42	8.04	6.58				
87-1	115P04411	4 Evening	Weekday	AZ-87	Northbound	36.7	34.0	5.6	9.9	45	45	45	1.23	1.32	8.04	4.53				
87-1	115P04412	1 AM Peak	Weekday	AZ-87	Northbound	47.3	46.8	19.9	19.9	65	65	65	1.37	1.39	3.27	3.27	1.37	1.47	3.98	3.88
87-1	115P04412	2 Mid Day	Weekday	AZ-87	Northbound	48.2	46.5	18.7	20.5	65	65	65	1.35	1.40	3.48	3.18				
87-1	115P04412	3 PM Peak	Weekday	AZ-87	Northbound	49.8	44.2	16.3	16.8	65	65	65	1.30	1.47	3.98	3.88				
87-1	115P04412	4 Evening	Weekday	AZ-87	Northbound	49.8	46.8	21.7	20.5	65	65	65	1.30	1.39	2.99	3.18				
87-1	115P04413	1 AM Peak	Weekday	AZ-87	Northbound	59.0	61.2	38.1	55.3	65	65	65	1.10	1.06	1.71	1.18	1.10	1.08	1.74	1.18
87-1	115P04413	2 Mid Day	Weekday	AZ-87	Northbound	60.2	60.7	37.4	55.3	65	65	65	1.08	1.07	1.74	1.18				
87-1	115P04413	3 PM Peak	Weekday	AZ-87	Northbound	63.0	60.4	46.4	55.3	65	65	65	1.03	1.08	1.40	1.18				
87-1	115P04413	4 Evening	Weekday	AZ-87	Northbound	62.7	60.8	47.4	55.3	65	65	65	1.04	1.07	1.37	1.18				
87-1	115P04414	1 AM Peak	Weekday	AZ-87	Northbound	57.3	56.5	29.8	23.6	65	65	65	1.13	1.15	2.18	2.75	1.13	1.18	2.30	3.88
87-1	115P04414	2 Mid Day	Weekday	AZ-87	Northbound	58.3	55.9	32.0	25.3	65	65	65	1.11	1.16	2.03	2.57				
87-1	115P04414	3 PM Peak	Weekday	AZ-87	Northbound	59.6	55.1	30.8	16.8	65	65	65	1.09	1.18	2.11	3.88				
87-1	115P04414	4 Evening	Weekday	AZ-87	Northbound	59.2	56.0	28.3	19.9	65	65	65	1.10	1.16	2.30	3.27				
87-2	115P04415	1 AM Peak	Weekday	AZ-87	Northbound	58.9	56.8	37.3	28.6	65	65	65	1.10	1.14	1.74	2.28	1.10	1.15	1.97	2.28
87-2	115P04415	2 Mid Day	Weekday	AZ-87	Northbound	59.8	56.9	33.6	33.6	65	65	65	1.09	1.14	1.94	1.94				
87-2	115P04415	3 PM Peak	Weekday	AZ-87	Northbound	60.8	56.7	33.0	30.9	65	65	65	1.07	1.15	1.97	2.11				
87-2	115P04415	4 Evening	Weekday	AZ-87	Northbound	60.3	57.6	35.4	34.8	65	65	65	1.08	1.13	1.84	1.87				
87-2	115P06123	1 AM Peak	Weekday	AZ-87	Northbound	54.6	55.7	24.9	25.5	65	65	65	1.19	1.17	2.61	2.55	1.19	1.23	2.76	3.17
87-2	115P06123	2 Mid Day	Weekday	AZ-87	Northbound	55.0	54.1	23.6	26.7	65	65	65	1.18	1.20	2.76	2.43				
87-2	115P06123	3 PM Peak	Weekday	AZ-87	Northbound	56.2	52.7	25.5	20.5	65	65	65	1.16	1.23	2.55	3.17				
87-2	115P06123	4 Evening	Weekday	AZ-87	Northbound	57.5	55.8	28.5	29.7	65	65	65	1.13	1.16	2.28	2.19				
87-3	115P05704	1 AM Peak	Weekday	AZ-87	Northbound	62.0	59.4	44.7	48.5	65	65	65	1.05	1.09	1.45	1.34	1.05	1.11	1.54	1.38
87-3	115P05704	2 Mid Day	Weekday	AZ-87	Northbound	62.7	59.1	42.3	50.3	65	65	65	1.04	1.10	1.54	1.29				
87-3	115P05704	3 PM Peak	Weekday	AZ-87	Northbound	63.9	58.8	49.1	47.2	65	65	65	1.02	1.11	1.32	1.38				
87-3	115P05704	4 Evening	Weekday	AZ-87	Northbound	62.4	58.4	49.7	49.4	65	65	65	1.04	1.11	1.31	1.32				
87-4	115P05705	1 AM Peak	Weekday	AZ-87	Northbound	61.0	49.0	43.7	29.1	65	65	65	1.07	1.33	1.49	2.24	1.17	1.37	2.05	2.38
87-4	115P05705	2 Mid Day	Weekday	AZ-87	Northbound	61.1	49.2	40.4	31.1	65	65	65	1.06	1.32	1.61	2.09				
87-4	115P05705	3 PM Peak	Weekday	AZ-87	Northbound	59.4	48.0	35.4	28.2	65	65	65	1.09	1.35	1.83	2.30				
87-4	115P05705	4 Evening	Weekday	AZ-87	Northbound	55.6	47.3	31.7	27.3	65	65	65	1.17	1.37	2.05	2.38				
87-5	115P07387	1 AM Peak	Weekday	AZ-87	Northbound	64.6	58.6	47.9	45.3	65	65	65	1.01	1.11	1.36	1.43	1.01	1.12	1.42	1.45
87-5	115P07387	2 Mid Day	Weekday	AZ-87	Northbound	64.5	58.4	45.7	44.7	65	65	65	1.01	1.11	1.42	1.45				
87-5	115P07387	3 PM Peak	Weekday	AZ-87	Northbound	65.2	58.3	50.4	45.3	65	65	65	1.00	1.12	1.29	1.43				

Segment	TMC	timeperiod	week type	road number	road direction	cars mean	trucks mean	cars P05	trucks P05	Posted Speed limit	Assumed car free-flow speed	Assumed truck free-flow speed	cars TTI	Trucks TTI	cars PTI	Trucks PTI	Cars PeakTTI	Trucks PeakTTI	Cars PeakPTI	Trucks PeakPTI
87-5	115P07387	4 Evening	Weekday	AZ-87	Northbound	64.5	58.9	53.4	47.4	65	65	65	1.01	1.10	1.22	1.37				
87-6	115P07820	1 AM Peak	Weekday	AZ-87	Northbound	58.9	42.7	33.5	26.7	65	65	65	1.10	1.52	1.94	2.43	1.31	1.55	2.38	2.52
87-6	115P07820	2 Mid Day	Weekday	AZ-87	Northbound	59.5	44.0	31.8	27.3	65	65	65	1.09	1.48	2.04	2.38				
87-6	115P07820	3 PM Peak	Weekday	AZ-87	Northbound	56.3	41.9	28.7	26.7	65	65	65	1.16	1.55	2.26	2.43				
87-6	115P07820	4 Evening	Weekday	AZ-87	Northbound	49.8	42.1	27.3	25.8	65	65	65	1.31	1.54	2.38	2.52				
87-7	115P07388	1 AM Peak	Weekday	AZ-87	Northbound	55.5	47.2	29.9	28.6	45	45	45	1.00	1.00	1.51	1.57	1.00	1.00	1.81	2.56
87-7	115P07388	2 Mid Day	Weekday	AZ-87	Northbound	54.4	47.1	26.7	23.6	45	45	45	1.00	1.00	1.68	1.91				
87-7	115P07388	3 PM Peak	Weekday	AZ-87	Northbound	53.2	45.1	24.8	17.6	45	45	45	1.00	1.00	1.81	2.56				
87-7	115P07388	4 Evening	Weekday	AZ-87	Northbound	51.6	46.7	26.6	26.7	45	45	45	1.00	1.00	1.69	1.68				

Car TTI and PTI/Truck TTTI and TPTI – Eastbound/Westbound

Segment	TMC	timeperiod	week_type	ROAD_NUMBER	road_direction	cars_mean	trucks_mean	cars_P05	trucks_P05	Posted Speed limit	Assumed car free-flow speed	Assumed truck free-flow speed	cars_TTI	Trucks_TTI	cars_PTI	Trucks_PTI	Cars_PeakTTI	Trucks_PeakTTI	Cars_PeakPTI	Trucks_PeakPTI
64-1	115P05909	1 AM Peak	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	60	60	60	#VALUE!	#VALUE!	#VALUE!	#VALUE!	No Data	No Data	No Data	No Data
64-1	115P05909	2 Mid Day	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	60	60	60	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-1	115P05909	3 PM Peak	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	60	60	60	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-1	115P05909	4 Evening	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	60	60	60	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-1	115P05910	1 AM Peak	Weekday	AZ-64	Eastbound	64.771	60.4648	49.8938	46.5969	65	65	65	1.00	1.07	1.30	1.39	1.03	1.15	1.43	No Data
64-1	115P05910	2 Mid Day	Weekday	AZ-64	Eastbound	63.408	59.812	47.5749	41.6437	65	65	65	1.02	1.08	1.36	1.55				
64-1	115P05910	3 PM Peak	Weekday	AZ-64	Eastbound	63.58	56.0745	47.221	#VALUE!	65	65	65	1.02	1.15	1.37	#VALUE!				
64-1	115P05910	4 Evening	Weekday	AZ-64	Eastbound	62.821	61.1271	45.397	44.7567	65	65	65	1.03	1.06	1.43	1.45				
64-1	115P06990	1 AM Peak	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	65	65	65	#VALUE!	#VALUE!	#VALUE!	#VALUE!	No Data	No Data	No Data	No Data
64-1	115P06990	2 Mid Day	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	65	65	65	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-1	115P06990	3 PM Peak	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	65	65	65	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-1	115P06990	4 Evening	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	65	65	65	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-1	115P06991	1 AM Peak	Weekday	AZ-64	Eastbound	65.863	62.6913	55.9792	53.3493	65	65	65	1.00	1.04	1.16	1.22	1.00	1.07	1.20	1.54
64-1	115P06991	2 Mid Day	Weekday	AZ-64	Eastbound	65.33	63.8551	54.821	52.6427	65	65	65	1.00	1.02	1.19	1.23				
64-1	115P06991	3 PM Peak	Weekday	AZ-64	Eastbound	65.496	60.8359	55.5878	42.2822	65	65	65	1.00	1.07	1.17	1.54				
64-1	115P06991	4 Evening	Weekday	AZ-64	Eastbound	65.243	65.0658	54.0752	51.6172	65	65	65	1.00	1.00	1.20	1.26				
64-1	115P06992	1 AM Peak	Weekday	AZ-64	Eastbound	65.993	61.562	56.2595	28.5979	65	65	65	1.00	1.06	1.16	2.27	No Data	No Data	No Data	No Data
64-1	115P06992	2 Mid Day	Weekday	AZ-64	Eastbound	65.474	61.2304	55.9266	22.9966	65	65	65	1.00	1.06	1.16	2.83				
64-1	115P06992	3 PM Peak	Weekday	AZ-64	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	65	65	65	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-1	115P06992	4 Evening	Weekday	AZ-64	Eastbound	65.179	64.0124	52.3634	56.5964	65	65	65	1.00	1.02	1.24	1.15				
64-1	115P06993	1 AM Peak	Weekday	AZ-64	Eastbound	66.319	63.1831	58.1721	51.9444	65	65	65	1.00	1.03	1.12	1.25	1.00	1.07	1.19	No Data
64-1	115P06993	2 Mid Day	Weekday	AZ-64	Eastbound	65.911	63.532	57.8568	55.8878	65	65	65	1.00	1.02	1.12	1.16				
64-1	115P06993	3 PM Peak	Weekday	AZ-64	Eastbound	66.496	60.7669	57.8568	#VALUE!	65	65	65	1.00	1.07	1.12	#VALUE!				
64-1	115P06993	4 Evening	Weekday	AZ-64	Eastbound	65.656	64.2067	54.7414	53.5066	65	65	65	1.00	1.01	1.19	1.21				
64-2	115P06987	1 AM Peak	Weekday	US-180	Eastbound	63.265	57.5052	43.5067	28.6	62	62	62	1.00	1.08	1.43	2.17	1.03	1.17	2.84	3.57
64-2	115P06987	2 Mid Day	Weekday	US-180	Eastbound	61.982	58.2786	44.1081	19.8853	62	62	62	1.00	1.07	1.41	3.13				
64-2	115P06987	3 PM Peak	Weekday	US-180	Eastbound	61.596	53.0916	38.9084	24.8609	62	62	62	1.01	1.17	1.60	2.50				
64-2	115P06987	4 Evening	Weekday	US-180	Eastbound	60.05	56.26	21.8527	17.4027	62	62	62	1.03	1.10	2.84	3.57				
64-2	115P06988	1 AM Peak	Weekday	US-180	Eastbound	66.555	60.5646	58.7484	51.6089	65	65	65	1.00	1.07	1.11	1.26	1.01	1.10	1.21	1.36
64-2	115P06988	2 Mid Day	Weekday	US-180	Eastbound	65.555	61.908	57.057	54.6447	65	65	65	1.00	1.05	1.14	1.19				
64-2	115P06988	3 PM Peak	Weekday	US-180	Eastbound	66.264	63.4487	58.06	57.8341	65	65	65	1.00	1.02	1.12	1.12				
64-2	115P06988	4 Evening	Weekday	US-180	Eastbound	64.427	58.8772	53.7554	47.8691	65	65	65	1.01	1.10	1.21	1.36				
64-2	115P06989	1 AM Peak	Weekday	US-180	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	64	64	64	#VALUE!	#VALUE!	#VALUE!	#VALUE!	No Data	No Data	No Data	No Data
64-2	115P06989	2 Mid Day	Weekday	US-180	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	64	64	64	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-2	115P06989	3 PM Peak	Weekday	US-180	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	64	64	64	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-2	115P06989	4 Evening	Weekday	US-180	Eastbound	#VALUE!	#VALUE!	#VALUE!	#VALUE!	64	64	64	#VALUE!	#VALUE!	#VALUE!	#VALUE!				
64-3	115P06989	1 AM Peak	Weekday	US-180	Eastbound	42.259	44.1207	#VALUE!	#VALUE!	44	44	44	1.03	1.00	#VALUE!	#VALUE!	1.14	1.07	No Data	No Data
64-3	115P06989	2 Mid Day	Weekday	US-180	Eastbound	43.796	40.9735	#VALUE!	#VALUE!	44	44	44	1.00	1.07	#VALUE!	#VALUE!				
64-3	115P06989	3 PM Peak	Weekday	US-180	Eastbound	43.176	44.1062	#VALUE!	#VALUE!	44	44	44	1.01	1.00	#VALUE!	#VALUE!				
64-3	115P06989	4 Evening	Weekday	US-180	Eastbound	38.412	47.0756	#VALUE!	#VALUE!	44	44	44	1.14	1.00	#VALUE!	#VALUE!				

Segment	TMC	timeperiod	week_type	ROAD_NUMBER	road_direction	cars_mean	trucks_mean	cars_P05	trucks_P05	Posted Speed Limit	Assumed car free-flow speed	Assumed truck free-flow speed	cars_TTI	Trucks_TTI	cars_PTI	Trucks_PTI	Cars_PeakTTI	Trucks_PeakTTI	Cars_PeakPTI	Trucks_PeakPTI
64-2	115N06988	1 AM Peak	Weekday	US-180	Westbound	39.255	35.7053	9.9449	5.5932	64	64	64	1.63	1.80	6.45	11.47	1.63	1.89	6.45	11.47
64-2	115N06988	2 Mid Day	Weekday	US-180	Westbound	41.681	46.6909	12.7134	16.776	64	64	64	1.54	1.37	5.05	3.82				
64-2	115N06988	3 PM Peak	Weekday	US-180	Westbound	46.287	45.4801	21.7457	16.776	64	64	64	1.39	1.41	2.95	3.82				
64-2	115N06988	4 Evening	Weekday	US-180	Westbound	40.829	33.9147	12.223	11.1864	64	64	64	1.57	1.89	5.25	5.74				
64-2	115N06987	1 AM Peak	Weekday	US-180	Westbound	64.813	63.5319	56.1942	58.4022	65	65	65	1.00	1.02	1.16	1.11	1.01	1.06	1.20	1.27
64-2	115N06987	2 Mid Day	Weekday	US-180	Westbound	65.494	62.4422	57.2769	51.6089	65	65	65	1.00	1.04	1.13	1.26				
64-2	115N06987	3 PM Peak	Weekday	US-180	Westbound	65.999	63.1498	58.6326	53.7554	65	65	65	1.00	1.03	1.11	1.21				
64-2	115N06987	4 Evening	Weekday	US-180	Westbound	64.458	61.2644	54.345	50.9892	65	65	65	1.01	1.06	1.20	1.27				
64-2	115N06986	1 AM Peak	Weekday	US-180	Westbound	61.242	59.0953	38.6466	32.9293	63	63	63	1.03	1.07	1.64	1.92	1.05	1.23	1.64	4.63
64-2	115N06986	2 Mid Day	Weekday	US-180	Westbound	61.105	58.3993	41.1971	35.4062	63	63	63	1.04	1.08	1.54	1.79				
64-2	115N06986	3 PM Peak	Weekday	US-180	Westbound	61.823	58.3691	44.7265	31.6936	63	63	63	1.02	1.08	1.42	2.00				
64-2	115N06986	4 Evening	Weekday	US-180	Westbound	60.267	51.4964	42.165	13.6735	63	63	63	1.05	1.23	1.50	4.63				
64-2	115N06993	1 AM Peak	Weekday	AZ-64	Westbound	63.147	61.6314	47.8596	46.5908	45	45	45	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.04
64-2	115N06993	2 Mid Day	Weekday	AZ-64	Westbound	62.944	60.3237	47.2873	43.4549	45	45	45	1.00	1.00	1.00	1.04				
64-2	115N06993	3 PM Peak	Weekday	AZ-64	Westbound	64.164	62.2483	51.2726	50.6163	45	45	45	1.00	1.00	1.00	1.00				
64-2	115N06993	4 Evening	Weekday	AZ-64	Westbound	62.92	62.6663	49.276	50.9423	45	45	45	1.00	1.00	1.00	1.00				

Closure Data

Segment	Length (miles)	# of closures	Total miles of closures EB	Total miles of closures WB	Average Occurrences/Mile/Year EB	Average Occurrences/Mile/Year WB
64-1	28	11	46.3	4.0	0.33	0.03
64-2	21	7	29.0	1.0	0.28	0.01
64-3	3	2	3.0	1.0	0.20	0.07

	ITIS Category Description											
	Closures		Incidents/Accidents		Incidents/Crashes		Obstruction Hazards		Winds		Winter Storm Codes	
Segment	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**	**EB**	**WB**
64-1	0	0	0	0	0	0	0	0	0	0	0	0
64-2	0	0	0	0	0	0	0	0	0	0	0	0
64-3	0	0	0	0	0	0	0	0	0	0	0	0

HPMS Data

SEGMENT	MP_FROM	MP_TO	WEIGHTED AVERAGE EB AADT	WEIGHTED AVERAGE WB AADT	WEIGHTED AVERAGE AADT	EB AADT	WB AADT	2015 AADT	K Factor	D-Factor	T-Factor
64-1	185	213	2484	2484	4968	2442	2441	4883	10	50	14
64-2	213	234	2570	2464	5035	3155	2946	6102	12	52	16
64-3	234	237	3270	3247	6518	3604	3559	7163	8	50	14

SEGMENT	Loc ID	BMP	EMP	Length	Pos Dir AADT	Neg Dir AADT	Corrected Pos Dir AADT	Corrected Neg Dir AADT	2015 AADT	K Factor	D-Factor	D-Factor Adjusted	T-Factor
64-1	100707	185.00	191.09	6.09	3307	3306	3307	3306	6613	9	53	50	14
	100708	191.09	213.00	21.91	0	0	2201	2201	4402	10	56	50	14
64-2	100708	213.00	213.46	0.46	0	0	2201	2201	4402	10	56	50	14
	100709	213.46	234.00	20.54	3176	2963	3176	2963	6140	12	56	52	17
64-3	100709	234.00	234.64	0.64	3176	2963	3176	2963	6140	12	56	52	17
	100710	234.64	237.00	2.36	0	0	3721	3721	7441	7	58	50	13

Bicycle Accommodation Data

Segment	BMP	EMP	Divided or Non	EB Right Shoulder Width	WB Right Shoulder Width	EB Left Shoulder Width	WB Left Shoulder Width	EB Effective Length of Shoulder	WB Effective Length of Shoulder	% Bicycle Accommodation
64-1	185	213	Undivided	5.3	5.2	N/A	N/A	1.5	1.1	5%
64-2	213	234	Undivided	5.0	5.2	N/A	N/A	0.6	0.9	4%
64-3	234	237	Undivided	8.2	7.9	N/A	N/A	2.9	2.8	95%

AZTDM Data

SEGMENT	Growth Rate	% Non-SOV
64-1	-0.09%	13.9%
64-2	1.53%	16.8%
64-3	1.77%	10.6%

HERS Capacity Calculation Data

Segment	Capacity Environment Type	Facility Type	Terrain	Lane Width	EB Rt. Shoulder	WB Rt. Shoulder	F_{lw} or f_w or f_{LS}	EB F_{lc}	WB F_{lc}	Total Ramp Density	PHF	E_T	f_{HV}	f_M	f_A	g/C	f_G	f_{NP}	Nm	f_p	EB FFS	WB FFS	EB Peak-Hour Capacity	WB Peak-Hour Capacity	Major Direction Peak-Hour Capacity	Daily Capacity
64-1	4	Rural	Rolling	12.00	5.26	5.20	0.0	N/A	N/A	N/A	0.88	1.5	0.934	N/A	0.59	N/A	1	4	3.30	N/A	74.41	74.41	N/A	N/A	1648.30	31,396
64-2	4	Rural	Rolling	12.00	5.04	5.19	0.0	N/A	N/A	N/A	0.88	1.3	0.954	N/A	0.51	N/A	1	4	2.30	N/A	73.49	73.49	N/A	N/A	1687.40	32,141
64-3	3	Rural	Rolling	12.00	8.22	7.87	1.0	N/A	N/A	N/A	0.9	1.5	0.934	N/A	0.59	N/A	1	4	3.30	N/A	N/A	N/A	N/A	N/A	825.00	15,714

Safety Performance Area Data

Segment	Operating Environment	Segment Length (miles)	EB Fatal Crashes 2010-2014	WB Fatal Crashes 2010-2014	EB Incapacitating Injury Crashes	WB Incapacitating Injury Crashes	Fatal + Incapacitating Injury Crashes Involving SHSP Top 5 Emphasis Areas Behaviors
64-1	2 or 3 Lane Undivided Highway	28	1	0	1	3	1
64-2	2 or 3 Lane Undivided Highway	21	0	1	2	2	3
64-3	4 or 5 Lane Undivided Highway	3	0	0	0	1	0

Segment	Operating Environment	Fatal + Incapacitating Injury Crashes Involving Trucks	Fatal + Incapacitating Injury Crashes Involving Motorcycles	Fatal + Incapacitating Injury Crashes Involving Non-Motorized Travelers	Weighted 5-Year (2011-2015) Average EB AADT	Weighted 5-Year (2011-2015) Average WB AADT	Weighted 5-Year (2011-2015) Average Total AADT
64-1	2 or 3 Lane Undivided Highway	0	0	1	2468	2468	4935
64-2	2 or 3 Lane Undivided Highway	0	1	0	2577	2469	5047
64-3	4 or 5 Lane Undivided Highway	0	0	1	3458	3458	6917

HPMS Data

2010-2014 Weighted Average						2015			2014			2013			2012			2011		
SEGMENT	MP_FROM	MP_TO	WEIGHTED AVERAGE EB AADT	WEIGHTED AVERAGE WB AADT	WEIGHTED AVERAGE AADT	EB AADT	WB AADT	2015 AADT	EB AADT	WB AADT	2014 AADT	EB AADT	WB AADT	2013 AADT	EB AADT	WB AADT	2012 AADT	EB AADT	WB AADT	2011 AADT
64-1	185	213	2484	2484	4968	2442	2441	4883	2297	2297	4593	2802	2802	5605	2734	2734	5468	2146	2146	4292
64-2	213	234	2570	2464	5035	3155	2946	6102	2644	2556	5198	2376	2312	4690	2324	2277	4603	2352	2230	4584
64-3	234	237	3270	3247	6518	3604	3559	7163	3320	3301	6621	3199	3185	6385	3113	3102	6215	3115	3088	6204

Freight Performance Area Data

Segment	Length (miles)	# of closures	Total minutes of closures		Avg Mins/Mile/Year	
			EB	WB	EB	WB
64-1	28	11	37084.8	625.0	264.89	4.46
64-2	21	7	28496.0	121.0	271.39	1.15
64-3	3	2	3468.0	130.0	231.20	8.67

	ITIS Category Description											
	Closures		Incidents/Accidents		Incidents/Crashes		Obstruction Hazards		Winds		Winter Storm Codes	
Segment	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB
64-1	0	0	0	0	0	0	0	0	0	0	0	0
64-2	0	0	0	0	0	0	0	0	0	0	0	0
64-3	0	0	0	0	0	0	0	0	0	0	0	0

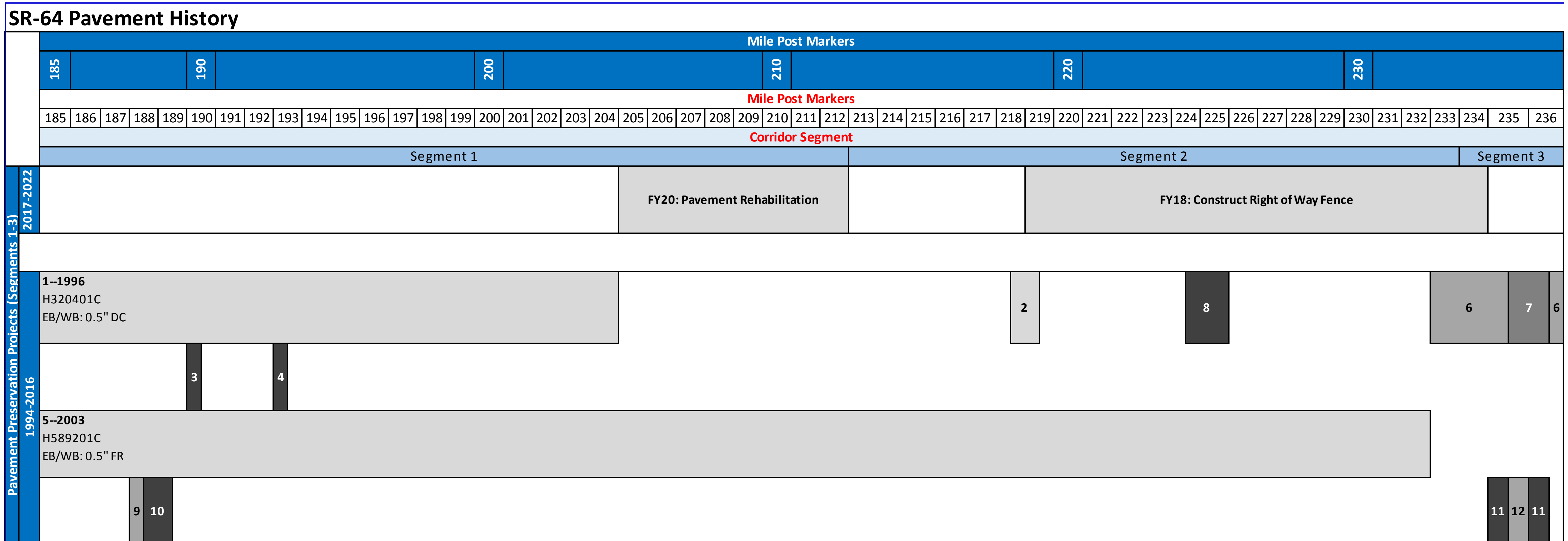
See the **Mobility Performance Area Data** section for other Freight Performance Area related data.

Appendix D: Needs Analysis Contributing Factors and Scores

Pavement Performance Needs Analysis

Segment	Segment Length (miles)	Segment Mileposts (MP)	Final Need	Bid History Investment	PeCos History Investment	Resulting Historical Investment	Contributing Factors and Comments
64-1	28	185-213	High	Low	Medium	Low	**Hot Spots:** MP 188-189, MP 198-200, MP 205-212 **Programmed Projects:** FY20 Pavement Rehabilitation: Pipeline Road to Air Park (ADOT Five-Year Transportation Facilities Construction Program 2018-2022, MP 205-213)
64-2	21	213-234	None	Low	Low	Low	**Programmed Projects:** FY18 Construct Right of Way Fence: MP 219 to Grand Canyon National Park (ADOT Five-Year Transportation Facilities Construction Program 2018-2022, MP 219-235)
64-3	3	234-237	None	Medium	Low	Medium	**Programmed Projects:** FY18 Construct Right of Way Fence: MP 219 to Grand Canyon National Park (ADOT Five-Year Transportation Facilities Construction Program 2018-2022, MP 219-235)

Pavement History



Pavement Treatment Reference Numbers	Pavement Treatment Reference Numbers
1. 1996 (EB/WB) H320401C: 0.5" DC	**7. 2003 (EB/WB)** H525201C: Remove 2", New 2" AR, 0.5" FR
2. 1999 (EB/WB) H375601C: 0.5" DC	**8. 2006 (EB/WB)** H602701C: 10" AB, 5" AR, 0.5" FR
3. 1999 (EB/WB) H508601C: 10" AB, 4" AC, 0.5" DC	**9. 2008 (EB/WB)** H681301C: Remove 0.5", New 0.5" FR
4. 1999 (EB/WB) H412701C: 6" AB, 4" AC, 0.5" DC	**10. 2008 (EB/WB)** H681301C: 7" AB, 8" AC, 0.5" FR
5. 2003 (EB/WB) H589201C: 0.5" FR	**11. 2012 (EB/WB)** H692701C: 9" AB, 6" AC, 0.5" FC
6. 2003 (EB/WB) H525201C: 2" AR, 0.5" FR	**12. 2012 (EB/WB)** H692701C: Remove 0.5" New 0.5" FC

Legend

- New Paving or Reconstruction
- Mill and Overlay (Adding Structural Thickness)
- Mill and Replace (No Change Structural Thickness)
- Fog Coat or Thin Overlay Treatments
- PCCP Pavement Border
- AC Pavement Border

Value	Level	Segment Number					
		1		2		3	
		Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir	Uni-Dir	Bi-Dir
1	L1		71%		95%		
1			100%		5%		
1							
1							
3	L2		2%		5%		67%
3							17%
3							
3							
3							
3							
4	L3						33%
4							
4							
4							
6	L4		2%		7%		33%
6			2%				
6			4%				
6							
6							
6							
Sub-Total		0.0	2.2	0.0	1.6	0.0	5.8
Total		**2.2**		**1.6**		**5.8**	

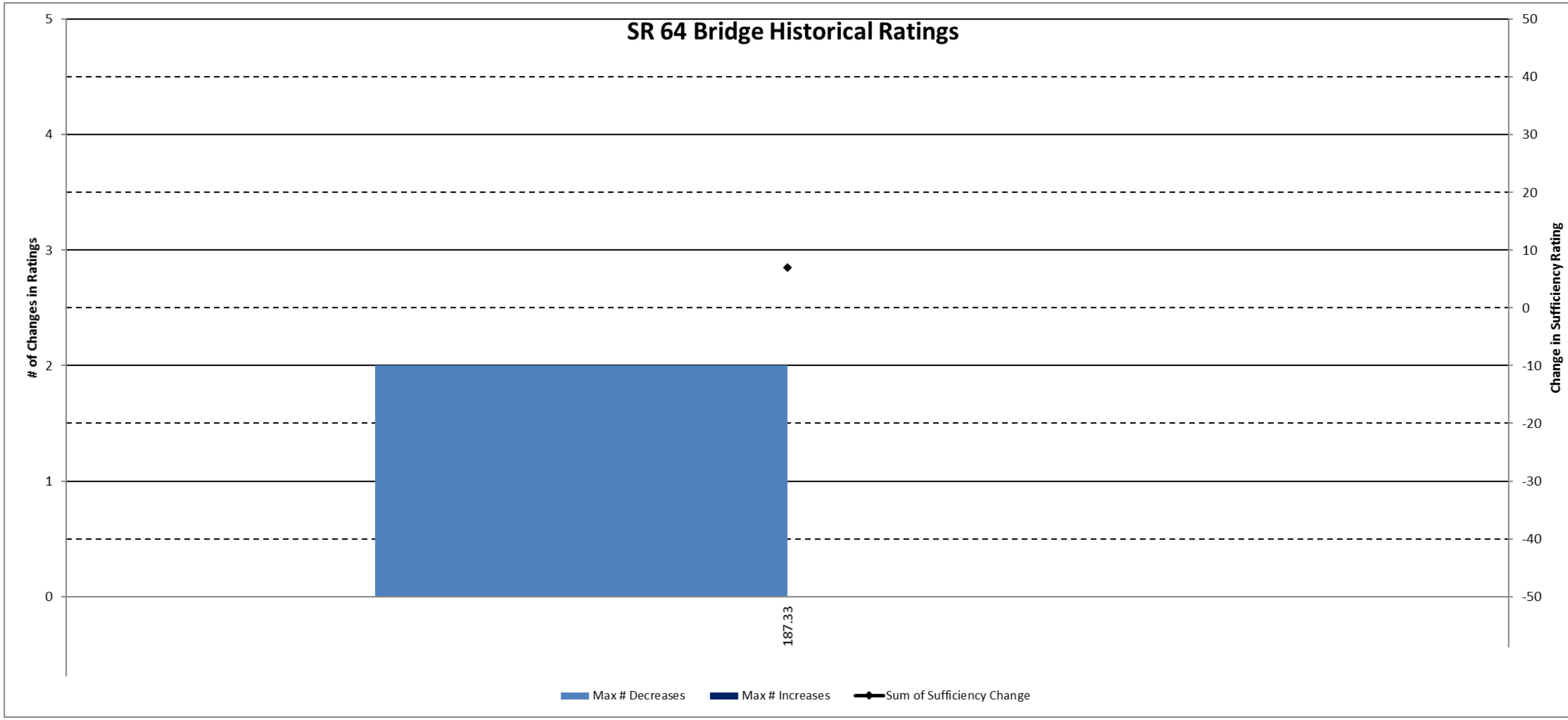
Pavement Historical Investment

Segment	Pavement History Value (bid projects)	Pavement History Score (bid projects)	Pavement History (bid projects)	PeCos ($/mile/yr)	PeCos Score	PeCos	Resulting Historical Investment
87-1	2.20	-0.56	Low	$1,898.49	-0.21	Medium	Low
87-2	1.60	-1.59	Low	$130.45	10.04	Low	Low
87-3	5.80	-1.11	Medium	$38.21	1.64	Low	Medium

Bridge Performance Needs Analysis

Segment	Segment Length (Miles)	Segment Mileposts (MP)	Number of Bridges in Segment	# Functionally Obsolete Bridges	Final Need	Contributing Factors			Comments
						Bridge	Current Ratings	Historical Review	
64-1	28	185-213	1	0	None	No bridges with current ratings less than 6 and no historical issues			
64-2	21	213-234	0	0	None	No bridges in segment			
64-3	3	234-237	0	0	None	No bridges in segment			

Bridge Ratings History



O identifies the bridge indicated is of concern from a historical ratings perspective

Maximum # of Decreases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating decreased from 1997 to 2014. (Higher number could indicate a more dramatic decline in the performance of the bridge)

Maximum # of Increases: Maximum number of times that the Deck Rating, Substructure Rating, or Superstructure Rating increased from 1997 to 2014. (Higher number could indicate a higher level of investment)

Change in Sufficiency Rating: Cumulative change in Sufficiency Rating from 1997 to 2014. (Bigger negative number could indicate a more dramatic decline in the performance of the bridge)

Mobility Performance Needs Analysis

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Mobility Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Weighted Average Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	EB Buffer Index (PTI-TTI)	WB Buffer Index (PTI-TTI)	
64-1	185-213	28	Low	State Highway	Rural	Level	2	65	No	Non-Divided	40%	A/B	A/B	14%	0.26	0.53	
64-2	213-234	21	Low	State Highway	Rural	Level	2	64	No	Non-Divided	41%	A/B	A/B	16%	1.00	1.40	
64-3	234-237	3	None	State Highway	Rural	Level	2	44	No	Non-Divided	16%	A/B	C	14%	-0.07	0.88	

Mobility Performance Needs Analysis (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
64-1	185-213	28	Low	11	10	91%	0	0%	1	9%		Programmed: None Planned: None	- Candidate for Shoulder Improvements (MP 185 - 234)
64-2	213-234	21	Low	7	6	86%	0	0%	1	14%		Programmed: None Planned: None	- Candidate for Shoulder Improvements (MP 185 - 234)
64-3	234-237	3	None	2	1	50%	0	0%	1	50%		Programmed: None Planned: None	- Candidate for SB Shoulder Improvements

Safety Performance Needs Analysis

Segment Number		64-1	64-2	64-3	Corridor-Wide Crash Characteristics
Segment Length (miles)		28	21	3	
Segment Milepost (MP)		185 - 213	213 - 234	234 - 237	
Final Need		None	None	None	
Segment Crash Overview		1 Crashes were fatal 4 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	1 Crashes were fatal 4 Crashes had incapacitating injuries 0 Crashes involve trucks 1 Crashes involve Motorcycles	0 Crashes were fatal 1 Crashes had incapacitating injuries 0 Crashes involve trucks 0 Crashes involve Motorcycles	2 Crashes were fatal 9 Crashes had incapacitating injuries 0 Crashes involve trucks 1 Crashes involve Motorcycles
Segment Crash Summaries (Fatal and Serious Injury Crashes)	First Harmful Event Type	40% Involve Collision with Motor Vehicle 20% Involve Overturning 20% Involve Collision with Bicyclist	40% Involve Overturning 40% Collision with Animal 20% Involve Collision with Motor Vehicle	N/A - Sample size too small	27% Involve Collision with Motor Vehicle 27% Involve Collision with Motor Vehicle 18% Involve Collision With Animal
	Collision Type	40% Involve Single Vehicle 40% Involve Head On 20% Involve Rear End	80% Involve Single Vehicle 20% Involve Left Turn	N/A - Sample size too small	55% Involve Single Vehicle 18% Involve Head On 9% Involve Left Turn
	Violation or Behavior	20% Involve No Improper Action 20% Involve Failure to Keep in Proper Lane 20% Involve Other Unsafe Passing	20% Exceeded Lawful Speed 20% Failure to Yield Right-of-Way 20% Failure to Keep in Proper Lane	N/A - Sample size too small	18% Involve No Improper Action 18% Involve No Improper Action 18% Involve No Improper Action
	Lighting Conditions	60% Occur in Daylight Conditions 40% Occur in Dark-Unlighted Conditions	60% Occur in Daylight Conditions 20% Occur in Dusk Conditions 20% Occur in Dark-Unlighted Conditions	N/A - Sample size too small	55% Occur in Daylight Conditions 27% Occur in Dark-Unlighted Conditions 9% Occur in Dusk Conditions
	Surface Conditions	80% Involve Dry Conditions 20% Involve Snow Conditions	80% Involve Dry Conditions 20% Involve Ice/Frost Conditions	N/A - Sample size too small	82% Involve Dry Conditions 9% Involve Snow Conditions 9% Involve Snow Conditions
	First Unit Event	40% Involve a first unit event of Crossed Centerline 40% Motor Vehicle in Transport 20% Involve a first unit event of Ran Off the Road (Right)	40% Involve a first unit event of Collision with Animal 40% Run Off the Road (Right) 20% Involve a first unit event of Motor Vehicle in Transport	N/A - Sample size too small	27% Involve a first unit event of Ran Off the Road (Right) 27% Involve a first unit event of Ran Off the Road (Right) 18% Involve a first unit event of Collision with Animal
	Driver Physical Condition	80% No Apparent Influence 20% Under the Influence of Drugs or Alcohol	100% No Apparent Influence	N/A - Sample size too small	91% No Apparent Influence 9% Under the Influence of Drugs or Alcohol 0% Fatigued/Fell Asleep
	Safety Device Usage	60% Shoulder And Lap Belt Used 20% None Used 20% Helmet Used	40% Shoulder And Lap Belt Used 40% Air bage Deployed/Shoulder-Lap Belt 20% Helmet Used	N/A - Sample size too small	55% Shoulder And Lap Belt Used 18% Helmet Used 18% Helmet Used
Hot Spot Crash Summaries					
Previously Completed Safety-					
District Interviews/Discussions					
Contributing Factors					

Freight Performance Needs Analysis

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Roadway Variables								Traffic Variables					Relevant Freight Related Existing Infrastructure
				Functional Classification	Environmental Type (Urban/Rural)	Terrain	# of Lanes/ Direction	Weighted Average Speed Limit	Aux Lanes	Divided/ Non-Divided	% No Passing	Existing LOS	Future 2035 LOS	% Trucks	EB Buffer Index (TPTI-TTTI)	WB Buffer Index (TPTI-TTTI)	
64-1	185 - 213	28	High	State Highway	Rural	Rolling	2	65	No	Non-Divided	30%	A-C	A-C	14%	0.44	2.05	
64-2	213 - 234	21	High	State Highway	Rural	Rolling	2	64	No	Non-Divided	20%	A-C	A-C	52%	1.33	3.31	
64-3	234 - 237	3	Low	State Highway	Rural	Rolling	4	44	No	Non-Divided	0%	A-C	A-C	13%	-0.03	0.63	

Freight Performance Needs Analysis (continued)

Segment	Segment Mileposts (MP)	Segment Length (miles)	Final Need	Closure Extent							Non-Actionable Conditions	Programmed and Planned Projects or Issues from Previous Documents Relevant to Final Need	Contributing Factors
				Total Number of Closures	# Incidents/ Accidents	% Incidents/ Accidents	# Obstructions/ Hazards	% Obstructions/ Hazards	# Weather Related	% Weather Related			
64-1	185-213	28	Low	11	10	91%	0	0%	1	9%		Programmed: None Planned: None	- Candidate for Shoulder Improvements (MP 185 - 234)
64-2	213-234	21	Low	7	6	86%	0	0%	1	14%		Programmed: None Planned: None	- Candidate for Shoulder Improvements (MP 185 - 234)
64-3	234-237	3	None	2	1	50%	0	0%	1	50%		Programmed: None Planned: None	- Candidate for SB Shoulder Improvements

Needs Summary Table

Performance Area	64-1	64-2	64-3
	MP 185-213	MP 213-234	MP 234-237
Pavement+	High	None	None
Bridge	None	None	None
Mobility+	Low	Low	None
Safety+	None	None	None
Freight	High	High	Low
Average Need	1.38	0.92	0.23

* Identified as an emphasis area for the SR 64

⁺ A segment need rating of 'None' does not indicate a lack of needed improvements; rather, it indicates that the segment performance score exceeds the established performance thresholds and strategic solutions for that segment will not be developed as part of this study

Level of Need	Average Need Range
None⁺	< 0.1
Low	0.1 - 1.0
Medium	1.0 - 2.0
High	> 2.0